Regd. No. M. 2799

Current Science

Vol. 17, No. 4 APRIL 1948 Pages 105-135

THREE USEFUL BOOKS PUBLISHED BY THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

I.C.A.R. Organization and Functions, Part I
(Just published. Price Re. 1-8-0 excluding postage)

Describes the administrative set-up of the Indian Council of Agricultural Research, Central Agricultural Research Institutes and allied organizations. Particularly useful to Provinces, States, Central Institutes, Universities and other institutions seeking aid from the Council in respect of agricultural research schemes.

I.C.A.R. Organization and Functions, Part II
(In press. Price Re. 1-8-0 excluding postage)

Contains the results of researches so far sponsored by the Council and the Central Institutes with lists of expired and current schemes of the Council.

I.C.A.R. Directory
(In press. Price Re. 1-8-0 excluding postage)

This contains lists of administrative and technical officers of the Council, the research workers employed under its schemes as well as under the Central Research Institutes, Commodity Committees, etc.

Copies can be obtained from the Secretary, Indian Council of Agricultural Research, Keeling Road, New Delhi.

INDIAN INSTITUTE OF SCIENCE
BANGALORE, 3

Applications are invited to the posts of:

1. Professor and Head of the Department of Aeronautical Engineering,
2. Professor and Head of the Department of Internal Combustion Engineering

at the Institute on a suitable pay in the grade Rs. 1,000-50-1,250 and an Overseas Allowance of Rs. 250 p.m. in the case of candidates of non-Asiatic domicile and a personal pay not exceeding Rs. 450 per month in the case of candidates with very high qualifications.

The work of the Department of Aeronautical Engineering includes both post-graduate teaching in preparation for the Diploma of the Institute and research, including that in a small wind tunnel. Applicants for No. 1 should have the following qualifications:—

1. Considerable teaching experience, which should include public examination work and the equipping of teaching departments.
2. Wide range of experimental research, and participation in the successful design of air craft or similar project.

Research experience should embrace full scale work, including flying experience (number of flying hours to be [stated), wind tunnel work, engine cooling, turbine research, model dropping, and experiments in water. Some experience of theoretical work, particularly on performance and stability is desirable.

Applicants for No. 2 should possess an Honours Degree in Mechanical Engineering of a British University or other equivalent qualifications. He should have served an apprenticeship in an Engineering firm of repute or have had other adequate works experience. Long experience of Internal Combustion Engineering Research and Development as also an international reputation for papers read, researches published and inventions adopted will be considered as essential. In addition to this experience of building up an Internal Combustion Engineering Research Laboratory and equipping it partly with apparatus of original design and responsible experience of design, manufacture, inspection, testing, installation and use of I.C. Engines in Europe and the U.S.A. are also required. Candidates should also be active members of a Professional Engineering Institution with experience of Technical Committee work and teaching.

The selected candidates will be on probation for a period of two years after which, if confirmed, they will continue till the 30th June following the age of 55 years. The Council of the Institute may grant an extension of appointment beyond the age of 55 provided the candidate is found efficient and the extension is in the interests of the Institute. The selected candidates shall join the Provident Fund of the Institute, the rate of subscription being 8⅓% of their salary, the Institute contributing an equivalent amount.

They shall be provided with houses, if available, situate on the grounds of the Institute in which they will be required to reside and rent therefor shall be charged as may be prescribed in the By-laws of the Institute for the time being in force. Leave and other privileges will be as determined by the Regulations and By-laws of the Institute for the time being in force.

Four copies of applications with four copies of testimonials should reach the undersigned on or before the 31st of July 1948. Candidates who have carried out original work or have published any papers will be expected to submit two sets of the same along with their applications. These will not be returned. A certificate of physical fitness from a recognised medical practitioner of the status of not less than a Civil Surgeon should accompany the application. Those already in employ should submit their applications through proper channel.

A. G. PAI
REGISTRAR

Current Science

Vol. XVII] APRIL 1948 [No. 4

CONSTITUTION OF INDIAN UNIVERSITIES*

IN his recent Convocation Address to the Travancore University, Sir John Sargent made two basic assumptions on which the main thesis of his address was based. The first was "that standards in Indian Universities are on the whole lower than in most Western Universities". He might, had it been relevant to his theme, have drawn a conclusion from this assumption and asserted that Indian Universities are held in less respect, both by their own alumni and by the public generally, than British Universities. When considering the constitution, the work, and the public estimation, or rather the estimation and respect of the learned world, of a young university like ours, it may be helpful, if we try to analyse some of the reasons why the universities of the West have earned such high and universal respect.

I am convinced that this great respect in which the universities of the West are held is inseparably linked with the absolute freedom which they enjoy, for they are, both constitutionally and actually, free from all extraneous interference or pressure. We in India have been accustomed for many years to pay lip-service to the ideals of "academic freedom" and "university autonomy", though with an uneasy conscience, for we are all conscious that universities in India have never been genuinely *free*. University autonomy and freedom, if it is to be genuine, must mean freedom from all forms of non-academic influence, authority and power.

The foundation of the freedom and autonomy of British Universities is to be found firstly in the method by which these universities are created. They are not founded by Acts of Parliament, but by Royal Charter granted by the Sovereign. Neither at the foundation nor at any subsequent amendment are the affairs or constitutions of British

* Abstract of an address by Mr. H. C. Papworth, Vice-Chancellor of the University of Travancore to the Senate of the University delivered on 8th March 1948.

Universities debated in Parliament, and in this way the possibility of any political interference or pressure in university affairs is completely removed. It may legitimately be regretted that the first three universities in India were founded in 1857 by a legislative Act and not by a Royal Charter, for this precedent undoubtedly set the norm for the foundation of Universities in India ever since, and the growth of political consciousness and the natural evolution of legislatures have been continual brakes upon any growth of real academic freedom.

Now that a new era has dawned, it should be possible, if we have the will and the necessary self-sacrificing and self-denying qualities, to remove universities from the control of legislatures, central or provincial, and to decree that the foundation of new universities and amendments to the constitutions of existing ones should be the prerogative of the Governor-General or of the Rulers of the States. This is the first method by which academic freedom and the respect which follows from it are secured to British Universities; and the history of the past ninety years seems to suggest that without it genuine autonomy and academic freedom for Indian Universities are impossible. This method of foundation was fortunately adopted in Travancore, this University having been founded by a Proclamation and Act of the Sovereign, and not by an Act of the legislature. I sincerely trust that all future amendments to this Act will be promulgated in the same manner. If this be done, it will be a considerable help in preventing the University from becoming the plaything of politics.

There are many other ways, apart from making universities dependent for their existence and constitution on a politically constituted legislature, in which undesirable interference or pressure can be exerted to the curtailment or negation of autonomy and freedom, and in referring to this question too, it is natural that one should look to the condition of British Universities as providing the ideal.

In the first place, the British Parliament sends no representatives to the Senates or other governing bodies of British Universities. One can legitimately wonder why, if it is not for the deliberate introduction of political interference and pressure, provision is made for the legislatures to send some of their members to the Senates of Indian Universities.

It has often been a matter of concern to many who have been brought up in another tradition that the Senates of most Indian Universities have been modelled on the plan of a legislative assembly. Further, the deliberations of the authorities of British Universities are not open to the press and are never reported, except by official announcements which a university may send to the press for public information. So there is no incentive for that partisan type of argument and debate which sometimes disfigures the deliberations of university bodies in India.

It is true that on the Courts or Councils of many British Universities, which correspond to the Senates of Indian Universities—the Senates of British Universities being composed exclusively of the Professors of the University—there are, in addition to educationists, representatives of other bodies and corporations. For example, the Court of Governors of the University of Manchester and of the larger cities and towns in the county of Lancaster. But these representatives are not 'elected'; they are chosen or picked out by their colleagues on the bodies of which they are members, and nominated by them as the most suitable persons to serve on a university authority. The same people might not be the most suitable persons to serve, for instance, on the County Transport Board, for which other persons would be chosen and nominated, who might not, in turn, be at home on a university authority.

In addition to these wisely chosen representatives of public authorities, we find that many British Universities enlist the help of the professions, the learned societies, business and industry. Leeds University, which is situated in the heart of a big industrial area, has on its Court a number of representatives chosen by such associations as the Clothworkers' Company, the Skinners' Company, the Drapers' Company, as well as by the professional bodies like the Yorkshire Board of Legal Studies. The Universities of Liverpool and Sheffield have on their Courts a representative of all the other universities in the country nominated by the Chancellor of each university. In addition, they have a representative nominated by the Royal Society, the Royal Colleges of Physicians and Surgeons, the Law Society, the General Council of the Bar, the Institutions of Civil and Mechanical Engineers, the Royal Institution of British Architects, the Institution of Naval Architects and the Iron and Steel

Institute. It will be clearly seen that all the representatives so chosen are personally and daily concerned, each in his own professional or business sphere, with the work the universities do and with the fitness of the products they turn out. There are no elections in this matter. Fellows of Royal Societies and other self-respecting professional and business men would not offer themselves for 'election', and bear the indignity of standing against one another as candidates. That is one of the elements of elections which makes elections out of place in university spheres.

This freedom which British Universities possess to secure only the right men in their assemblies is a priceless gift of the Royal Charter, and it might be well worth fighting for in India.

With the advent of constitutional independence in India, have not the time and the opportunity arrived for us to consider these things and to take steps to secure the academic freedom of our universities and to raise their present somewhat middling status and reputation in the learned world ? If we are to do this, we must first tackle our constitutions, in which, if the British Universities can serve as a model, there is no room either for political or so-called 'popular' elements. Universities cannot be efficiently run either by politicians or by the public ; they should be the most secluded and exclusive institutions in our midst. Then alone can they remain untarnished and on a higher level than any other secular institution.

So, instead of the so-called 'constituencies' —the very word has a political connotation and, therefore, quite inappropriate in university parlance—which 'elect' so-called 'representatives' to the Senates of many Indian Universities, one would like to see their places taken by professional and commercial organizations, which are deeply and genuinely interested and concerned with the education we give, and, more important still, with the products we turn out. It is not the politicians or quasi-politicians, but the great professions and businesses of the country which are most intimately concerned and handicapped when the universities turn out so many misfits. One would, therefore, like to see a complete change of outlook on the part of the public generally, and a thorough overhaul of constitution of university assemblies. In addition to experienced educationists, principals of colleges and professors of university status, room should be made in the Senates of Indian Universities for representatives nominated by the Institution of Engineers of India, the Medical Councils of India, the Bar Associations, the Research Institutes, the Defence Forces, the Chambers of Commerce, the Trades Associations, the Mill-Owners' Associations, the Planters' Associations and other respected bodies and societies of this kind, whose unprejudiced guidance as to what they expect our highest seats of learning to achieve would be of inestimable value.

If this were done, and if our university constitutions were remodelled on these lines, we could eliminate all elections and all official nominations from the Senates of universities. This, I am convinced, is an ideal worth achieving.

LANGUAGE MEDIUM OF SCIENCE IN UNIVERSITIES

AT the Silver Jubilee Celebrations of the South Indian Science Association in Bangalore, a discussion was held on the 26th March on the subject of the Medium of Instruction in Science in Indian Universities. Eminent scientists, administrators and educationists participated in the debate which was presided over by Sir C. V. Raman.

Introducing the subject of discussion, the President emphasised the backwardness of India in Science education and research, and pointed out that, for the uninterrupted progress of science in the country, free interchange of knowledge with the world stream of scientific thought was indispensable.

The discussion took into consideration all the important aspects of the question including the necessity for bringing the knowledge of the progress and potentialities of modern science to the mass of people in India. most of whom are ignorant of English. The imperative need of scientists and technologists in India to keep always in contact with international work in their respective fields of specialisation was also considered. It was unanimously agreed that the objective of mass education in science could be best achieved by teaching science in secondary schools in the language of the province, retaining, however, the current English scientific terminology. In the universities and advanced institutions of scientific research, the speakers recommended that science should continue to be taught and scientific work to be published in English for a number of years to come, to avoid hampering the progress in the scientific advancement of the country.

ROSTER OF SCIENTIFIC AND TECHNICAL PERSONNEL, INDIA

T. N. RAMACHANDRA RAO
(*Indian Institute of Science, Bangalore*)

THE Roster of Scientific and Technical Personnel is a project which will make available in a central place, an index of all citizens of India, who have special scientific or technical qualification.

The main object of the Roster is to accurately map the human wealth of the nation. The rapid advance of scientific and technical knowledge makes it necessary that the nation should be in a position to call upon its specialised personnel in rapid and effective manner.

In Britain, by 1939, a register of scientific and technical personnel was completed under the supervision of the Royal Society. In the following year there was established in America a Council under the joint management of the National Resources Board and the Civil Service Commission, to compile a national roster. By 1943 a great deal of valuable information had been collected with a total of 630, 770 and consisting of physicians, dentists, veterinarians, chemists, engineers, physicists, mathematicians, geologists, economists, biologists, psychologists, etc.

In India, it is proposed to compile a Roster of Scientific and Technical men, under the auspices of the National Institute of Sciences, Delhi. Last year the National Institute made a country-wide appeal to the scientific workers to help them with the necessary information to compile the roster. But, judging from the recent appeal issued by the Prime Minister, the response was poor. Consequent on this decision, a small sub-committee was appointed to collect data in all the four zones (North, South, East and West) of India, concerning scientific man-power resources of the Nation.

The success of such a venture depends largely on the willing help the scientists and technologists render by furnishing necessary information at an early date; for to-day the question before the scientists in India should be, not "where they can serve" but "where they can serve best".

Here is given a brief resumé of the methods of compilation and working of the Roster.

The Roster should include all scientific and technical workers in India, who have either a University degree or suitable technical training under the guidance of qualified scientists.

The necessary information concerning individuals is secured by sending each professional man a general questionnaire to get qualitative information on about 20 items such as (*a*) geographical area, (*b*) linguistic ability, (*c*) technical qualification, (*d*) foreign travel, and such others.

There are two lists under which information is collected: one is the *'General List'* and the second is the *check list* for details of specialisation. The general list is prepared under the following broad groups with special check lists in each:—

(A) (*a*) Administration and Management, (*b*) Engineering and related fields, (*c*) Humanities, (*d*) Medical Sciences, (*e*) Physical Sciences, (*f*) Agricultural and Biological Sciences, (*g*) Raw Materials and Manufactured Products, (*h*) Social Sciences.

(B) The special check list will be drawn up by a committee of experts in each field and will reveal the special branches in which the candidate is proficient. This can be best illustrated by giving a check list related to *Engineering and related fields*:

Aeronautics, Architecture, Automotive, Chemical, Civil, Electrical, Heating, Ventilating, Refrigeration and Air-Conditioning, Mining and Metallurgy, Industrial Design, Motion Pictures, Mechanical, Naval-Architecture, Marine, Radio, Safety, Sanitary, Testing and Materials, Transit and Traffic Engineering.

With information thus collected, the Roster will be planned on a card-index system; with complete information concerning each individual. To give an idea of such a compilation, here is recorded the distribution in professional fields of men (241) and women (6) at the Indian Institute of Science, Bangalore, together with a classification of the academic training of the Scientific Personnel.

Field of Specialisation	Extent of Education			
	Doctors Degree	Masters Degree	Bachelors Degree	Total
1 Aeronautical ..	1	..	11	12
2 Automotive Engineering	..	1	8	9
3 Bacteriology Imnurology ..	..	..	7	7
4 Botany ..	..	3	..	3
5 Chemistry ..	14	45	36	95
6 Chemical Engineering	..	7	23	30
7 Civil Engineering	..	1	2	3
8 Electrical Engineering	1	12	30	43
9 Genetics ..	1	2	..	3
10 Geology ..	..	2	..	2
11 Heating (Air-conditioning)	..	..	..	..
12 History and Political Science	..	..	..	..
13 Languages ..	2	..	..	2
14 Mechanical Engineering	..	..	3	3
15 Mining and Metallurgy	2	5	9	16
16 Physics and Astronomy	2	7	4	13
7 Horticulture and Agriculture	..	2	1	3
18 Sociology ..	1	..	..	1
119 Statistics ..	..	1	..	1
20 Zoology ..	1	..	..	1
				247

Once started and organized, the Roster will be a continuous census of the scientific manpower of the nation. It requires expert administrative staff to develop all aspects of the

Roster, and it means funds. But the expense in maintenance and its continuation are very little as compared with other projects undertaken to conserve our national resources. The Roster will be of value to many constructive activities of the nation; such as (*a*) the effective use of the scientific talent available in the country, (*b*) to reveal the gaps in the present unco-ordinated growth of science and technology, (*c*) to help proper equipment of College faculties, (*d*) to supply service personnel to industries, (*e*) to suggest alternative names where team-work is likely to be broken up, (*f*) to safeguard going concerns like education and research by conservation of present personnel and to stop the drift of scientific and technical men to purely administrative lines.

It seems evident, therefore, that in times of war as well as peace, a central list of this sort will be a National Asset for the effective use of its Scientific and Technical man-power. It is up to the Scientists and Technologists in India to render all help towards an early compilation of the National Roster.

RESUMÉ ON SERIES CAPACITORS

H. V. GOPALAKRISHNA

(*Indian Institute of Science, Bangalore*)

THE American transmission and distribution system during the war had to be loaded to its more than maximum capacity calling on the resources of the engineers resulting in notable strides of improvement in the construction and protection of power capacitors to meet the exigency. However, in India, during that period, when imports were restricted and hence no further additions of plant were feasible, the exploring of raising of the capacity of the existing system was hardly given any attention and power was denied to many industries some of which could have been supplied power and gone a long way in the industrialisation of the country which we are all seeking to-day. Furthermore, heavy voltage drops could have been avoided and helped in the current to be delivered at an optimum voltage to all the consumers connected to the power system. In this respect the response of capacitors connected in series with the lines, otherwise called Series Capacitors is highly interesting.

Improvement in voltage regulation can be effected in several ways. The method of transmitting more power at higher voltages through larger wires or more number of parallel lines will involve higher cost of line construction and transformers and a corresponding increase in operating cost. Moreover, very little voltage regulation will be obtained by increasing the size of conductors beyond a certain limit because the controlling factor is chiefly the inductive reactance of the line. Induction regulators common now on rural lines have high internal losses and are not instantaneous in action. A change of voltage is necessary to actuate them and a time factor is involved to effect the correction. It might so happen that by the time correction is effected the demand for excess current has ceased and an overvoltage results. Synchronous Condensers for voltage regulation, in large vogue at present, have losses varying from about one and a half per cent. of their rating on very large sizes to about five per cent. of their rating on smaller sizes and the machines with their control equipment are complicated and require periodic inspection and proper maintenance. The Shunt Capacitors like synchronous condensers improve voltage regulation by improving power factor. If they are left on circuits at light loads a voltage rise will occur at the distribution points which may be as disadvantageous as too low a voltage.

Series Capacitors provide automatic voltage regulation from light load to full load changes in the circuit. They also tend to lessen the initial cost of a new circuit by making possible the use of a smaller size of wire for a given power with a given voltage drop. The reactance of a system has a predominant effect on the maximum power that could be conveyed over a line. It should be kept as low as possible and the method by which it could be reduced to a minimum is to alter the spacing which is, of course, governed by voltage, corona and mechanical considerations. The series capacitors nullify the inductive reactance of the line and transformers and it approximates the line to characteristics of direct current transmission. Their use enables the existing system to carry greater load than what could be handled by increasing the wire size.

It is common experience that due to reduced voltage induction motors sometimes start slowly or refuse to start through the action of the undervoltage device. Fluctuating, intermittent and suddenly applied loads such as, the working of the rolling mills, resistance welding machines impose difficult load conditions on the power system from the standpoint of feeder regulation and capacity. It is felt that these types of applications have a great future in our country since the use of electricity is playing a larger and larger part in welding, etc. From the economics point of view the power company cannot cater to such needs. Herein the series capacitors are of considerable advantage to other types of equipment for providing automatic voltage regulation.

The series capacitors have recently been used with success in improving the regulation of high frequency generators to supply power to induction furnaces. These generators are single phase, and the very nature of their design indicates that they have high reactance which causes very poor regulation.

On high voltage long transmission lines the series capacitors can be used to increase the stability limit of the circuits in which they are connected. They also find application in improving load division by alteration of the impedance of parallel circuits.

The series capacitors also excel other commercial apparatus in their characteristics of low losses which are of the order of 0·25 per cent. of their rating. Being static and sealed-off devices they require practically no maintenance or attendance; nor any specially prepared

foundations are needed for their installation. The series capacitors thus provide a broad field of service in power systems and may well be given thought to in the proposed network of transmission and distribution lines in India.

1. Shelton, E. K., "Series Capacitor Installation, N Y.," *G. E. Review*, Aug 1928, **31**, pp 432–4. 2. Moler, C. C., "Series Capacitors Regulate Rural Voltages Economically," *Electrical World*, Sept. 1939, **23**. 3. Alimansky M. I., "Application and Performance of Series Capacitors." *G. E. Review*, Nov. 1930, **33**, pp. 616–25. 4. Hill, W. S., "Series Capacitors Improve 4150 Volt Line Operation," *Ibid.*, Oct. 1933 **36**, p 461. 5. Dudley, C. L. and Snyder E. H., "Why Not Series Capacitors for Distribution Feeders" *Electrical World*, June 1930, **103**, pp. 942–5. 6. Buell, R. C., "Improved Voltage Regulation with Series Capacitors," *G. E. Review*. April 1937, **40**, pp. 174–9. 7. Lewis, J. J., "Largest Capacitor by Instantaneous Response Eliminates Stubborn Flicker, Originating in Industrial Load Off Residential Feeder" *Electrical World*. Nov. 1936, 7, **105**, pp. 3488–90. 8. Perreton, A. E., "Series Capacitors prove economical," *Ibid.*, Dec. 1936, **77**, p. 48. 9. Butler, J. W., and Concordia, C., "Analysis of Series Capacitor Application Problems," *A.I.E.E. Trans.*, Aug. 1937 Section, **56**, pp. 975–88. 10. Butler, J. W., "Capacitors and Circuit Performance," *Ibid.*, 1941, **60**, p. 408. 11. Allen, E. S., and Cantwell, J. L., "Effect of Series Capacitors upon Steady State Stability of Power Systems," *G. E. Review*., May, 1930, **33**, pp. 276–82. 12. Starr, E. C., and Evans, R. D., "Series Capacitors for Transmission Circuits," *A.I.E.E. Trans.*, 1942, **61**. pp 963–73. 13. Butler J. W., Paul, J. E., and Schæler, T. W., "Steady-State and Transient Stability Analysis of Series Capacitors in long Transmission Lines," *Ibid.*, Feb. 1943, **62**. pp. 53–65. 14. Hoard, B. V., "Characteristics of a 400-mile 230 KV Series-Capacitor-Compensated Transmission System," *Ibid.*, Aug. 1946, pp. 1102–14. 15. Peterson, H. A. and Shroeder, F. W., "Abnormal Overvoltages Caused by Transformer Magnetizing Currents in Long Transmission Lines," *Ibid.*, Jan. 1943, **62**, pp. 34–42. 16. Schultz, S. E., "500-mile 230 KV Series-Compensated Transmission," *Electrical World*., Aug. 17, 1946, p. 70-1. 17. Crary, S B., and Johnson, "A. C. Power Transmission Economics," *A. I. E. E. Trans.*, Aug. 1947, pp. 793–7.

PROFESSION OF CHEMISTRY IN INDIA*

PROF. FINDLAY said that he had been sent by the Royal Institute of Chemistry to convey their greetings to their members in the Indian Dominion and to consult the Indian colleagues as to the best way in which the Fellows of the Royal Institute of Chemistry here in India could build up a strong professional body like that of the parent body in Great Britain.

The Royal Institute of Chemistry, he continued, came into being 71 years ago as a result of the pressing demands of an Act in Great Britain called "The Food and Drugs Adulteration Act". At that time there was no standard of chemical competence in Great Britain which could fulfil the aims and objects of the "Food and Drugs Adulteration Act". When such was the state of affairs the Royal Institute of Chemistry was brought into being in order to (1) prescribe a standard of scientific competence for the profession of chemists; (2) see that the standard is maintained; (3) arrange for courses to produce chemists of the proper standard; (4) hold examinations in order to decide the eligibility for membership; and (5) safeguard the interests of chemists and chemical engineers in fixing their salaries in Government Departments, Factories and other concerns.

Professor Findlay then referred to the education of young men and women in Britain who were unable to attend the university for their education. He narrated the practice followed in Great Britain in this respect. Examinations were held and National Certificates were issued to the pupils. The examination papers would be approved by a competent body appointed jointly by the Education Ministry and the Royal Institute of Chemistry. According to them the Senior National Certificate is equivalent to a B.Sc. degree. Those candidates who attained necessary efficiency, after about two years of approved work would be eligible for admission to the Royal Institute of Chemistry.

"At the present it is your intention," Professor Findlay said, "to build up new industries and to develop your old ones. Those of you who are qualified for the profession should organise a strong professional body and build up in India such a high standard for the membership that you could speak with authority as to what must be done in the best interests of the country. It will be found advisable to form local centres of your professional bodies where you could come together from time to time and discuss problems of paramount importance to the country and for safeguarding the interests of the profession of chemistry. The body should not work for the benefit of its members only. It should always bear in mind the public interest. When I landed in Bombay I suggested to my colleagues there to form the local centre and to make use of the machinery available in Great Britain. Since you have been conferring D.Sc. and PH.D. degrees in almost all the universities, there will be no difficulty for you to fix up the standard for this Certificate. There are about 100 members of the Institute of Chemistry in India; and I have been sent here to offer to you on behalf of the Royal Institute, any assistance that you might need. Any suggestion which you have to make regarding simplification or alteration of the rules in order to meet the needs of this country will be welcomed. It has been agreed, for the present, to set up four branches of the Institute in India—at Bombay, Calcutta, Delhi and one in S. India. When these local centres have been established, I hope they will realise the importance of their duties in India and undertake to enrol for their professional body all the chemists qualified to become members. You can also maintain a register of qualified chemists.

"The whole plan should be in collaboration with the Ministry of Education in India. But for the full support and co-operation of this Ministry in Great Britain we would not have been able to build up the Institution to the status it now enjoys."

* Summary Report of an Address delivered by Prof Alexander Findlay, D.Sc., F.R.S., on 17th March 1948, at the Indian Institute of Science, Bangalore.

AGRICULTURAL PROBLEMS OF INDIA AFTER PARTITION*

ARABLE farming has been the predominant feature of Indian agriculture since times immemorial. Food crops cover the largest area followed by cash crops of different kinds. Mixed farming, including rearing of poultry, dairy farming and the growing of fruits and vegetables is practised by only a few. Vast bulk of the area under cultivation depends on an uncertain rainfall, the irrigated area representing only about 20 per cent. of the net area sown. The net result has been that the average yields per acre are low and compare unfavourably with those in the agriculturally advanced countries.

The shortage of food during the war made the Government awake to the importance of increased food production within the country, and special schemes were brought into operation for increasing food production. The Advisory Board of the Indian Council of Agricultural Research estimated that, for meeting the requirement of food for men and cattle in India, production must be increased by percentages ranging from 10 in the case of cereals to 400 in the case of oilcakes and other concentrates.

The revolutionary political changes of 1947, resulting in the exchange of population on a tremendous scale in some parts of the country, has accentuated certain long-standing agricultural problems and created certain fresh ones. The solution of the problems created by the accession of the food and cotton surplus areas in the North-West Punjab and Sind and the principal jute areas in East Bengal to Pakistan and the migration of four million people from Western Pakistan into the Indian Dominion can brook no delay.

It is most essential to co-ordinate the resettlement of refugees with the increased production of food and cash crops, by methods in harmony with the principles guiding India's industrial and social advancement. The All-India Congress Committee has very recently set up a sub-committee to evolve an economic structure which will yield maximum production without the creation of private monopolies and the concentration of wealth in a few hands. In respect of agricultural development, such a structure should, apart from securing rehabilitation of refugees, aim at achieving national as well as regional self-sufficiency in food production, at the same time guaranteeing balanced nutrition for all. The country's deficit in the long-staple cotton and jute should also be met with. The structure should also increase the cash income of the farmer and lead to the reconstruction and improvement of rural areas. Considering that low yields, poor quality produce, low wages and a very low standard of living, both for the agricultural labourer and the small farmer, are in no small measure due to the primitive methods and limited resources of the small peasant proprietors, it would appear that a solution of the country's agricultural problem lies in adopting 'group agriculture', employing modern methods with centralised farm management under expert supervision. Of the many different systems of group cultivation, 'co-operative farming' for the production of fruits, vegetables, poultry and dairy products and 'joint-stock company farming' for the growing of food, fodder and cash crops appear to hold the greatest promise of solving the immediate as well as the long-range agricultural problems of the country.

Farming by public utility companies should have the production of food grains as their primary objective. They should be financed jointly by the Government, farmer-producer and consumer and their policy determined by a Board representing all these interests. They should be under expert centralised management, the farmer-members actively working on the estates as partners and receiving an adequate share of the net profits as remuneration. The Government should receive a fixed percentage of the net profit as divided on the capital invested and in lieu of water rates, if any, and land assessment. The annual dividend on the investment of the consumer-members should be limited to a maximum of, say 10 per cent. The first option on the food grains which may be surplus to the legitimate requirements of the employees should rest with the Government. Training should be imparted to workers to increase their efficiency; they should also be provided with social amenities. The Government, for its part, should finance reseerch and experimental work needed for the area of operations of the companies.

A unique plan satisfying many of the principles mentioned above has been in operation in Sudan for the past twenty years in canal-irrigated areas of the Sennar Dam on Blue Nile. Here, a co-operative arrangement between the Government of Sudan, the cultivators and the managing company (The Sudan Plantation Syndicate) has resulted in the quick development of over 300,000 acres of irrigated area under the project. This plan with suitable modifications is advocated for the quick and scientific development of project areas, government lands as do not attract private cultivators in the beginning, and also for the existing cultivated areas where backward agricultural conditions prevail.

C. R. H.

* Summary of the Presidential Address delivered by Rai Bahadur Kalidas Sawhney to the Section of Agricultural Sciences, at the 35th Session, of the Indian Sci. Cong., at Patna, 1948.

OVERSEAS SCHOLARS

IT is proposed to publish periodically lists of the overseas scholars sponsored by the Central and Provincial Governments and the Indian States. The matter which will, in the first instance, appear in instalments in the columns of *Current Science*, is expected to be issued as a consolidated "Directory" at a later date.

Overseas scholars returning to this country are cordially invited to send in to the Editor particulars of their academic distinctions, research experience and their permanent address.

RECENT ADVANCES IN TROPICAL METEOROLOGY*

S. L. MALURKAR

(*Poona* 5)

INDIA is meteorologically the best equipped country in the tropics. A fresh approach in Tropical Meteorology would necessarily be of great use to India.

The rain associated with the S.W. monsoon feeds literally most of the persons in Asia. It is a good starting point and most other problems of tropical meteorology can be made to depend on it. Apart from what one learns in Physical Geography, extensive work has appeared on the subject.[1] Up to 1925, the idea of the S.W. monsoon was that it was due to the penetration of the 'S.E. Trades' into the northern hemisphere under the influence of the vast summer low pressure area over Asia. Blanford, Hemraj, Simpson, Doraiswamy Iyer and Normand took this view. The Indian monsoon was statistically connected with the high pressure area over S. America. The transport of fresh air from there to India was assumed to take place along the geographically shortest path, i.e., across extreme S. Africa and the 'roaring forties', then up along the 'S.E. Trades' almost up to the coast of E. Africa and then from the E. African coast to India across the Arabian Sea. As the idea is only implicit in papers by Hemraj, Walker and Doraiswamy Iyer, it was confirmed by consulting the last person. Meteorological observatories *were* maintained by the India Meteorological Department at Zanzibar and at Seychelles, showing thereby the importance attached to observations from these places rather than from places further east in the equatorial region. There was hardly any necessity to consider the monsoon in S.E. Asia. Doraiswamy Iyer[2] found much later that there was a great similarity in the summer rain over North Siam and over N.W. India as far as the statistical factors were concerned. The progressive delay in the dates of onset of the monsoon from the east to west did not disturb the earlier workers. The actual mechanism of the S.E. Trades crossing the equator was not definite; though epochs of high pressure in the S. hemisphere appear to have been pictured. For some reason after 1925, the idea of air crossing the equator receded into the background.

In the twenties of this century, the concept of air mass analysis was developed by Bjerknes and his school in Norway, and the idea captured Europe and America. The India Meteorological Department was equally enthusiastic to adopt newer methods of analysis. Roy and Roy (1930) looked into the question of air masses in the monsoon depressions in the Bay of Bengal. Their extent of observations was small. The methods adopted by them followed closely those used in extra-tropical latitudes. These imposed severe limitations on their conclusions. They found three air masses, *viz.*, (1) fresh monsoon air, (2) monsoon air desiccated and deflected by the hills in the N.E. angle of the Bay, or as sometimes designated as old monsoon air, and (3) dry continental air. Normand (1931) said that "the air mass concept was implicit" in the older workers in India. Wagner's[3] paper brought in a definite trend to the later thought. He utilised the upper air data which had considerably increased since Harwood. The picture of the S.W. monsoon was taken to be a vast stationary extra-tropical cyclone or a low pressure area after Bjerknes, i.e., with two air masses. Air from south of the equator did not enter into the picture. Investigations on individual cyclonic storms or depressions in the Indian Seas were undertaken with mostly local data.[1] (Depressions and cyclonic storms are essentially similar and either of the terms will be used here to denote the conditions for both). Doraiswamy Iyer[4] extended the life of many of the depressions of the Bay of Bengal to the Far East with scanty available data. Ramanathan and Ramakrishnan on the one hand and Sur on the other tried to improve on Wagner's ideas with later data.[5] The main idea was that the fresh monsoon air was produced in the N. Indian Ocean.. The southern hemisphere was not generally brought in even for argument, else some space would have been devoted to it. In his contribution to the Indian Science Congress in 1938, Normand apparently kept on to his old view though explicit mention is lacking. Ramanathan and Ramakrishnan in 1938[6] were sceptic about the role of even 'southerly air' in the pre-monsoon cyclonic storms and the text was substantially the same in the reprint of 1943. A study of the monthly mean upper winds could hardly be expected to give clear enough indications of short-period discontinuous incursions of fresh monsoon air from south of the equator. The trajectories that were drawn across wide stretches, based purely on existing observations suffered under the serious disability of not always providing correct clues. Most of the workers tried, somehow, to reduce the tropical depressions into particular cases of extra-tropical depressions of the Norwegian school. It was thought that though at the surface, the structure did not resemble an extra-tropical depression, it should or would do so at a higher level in view of differences in the lapse-rates in the different air masses. Terms like 'upper air fronts' were coined. A scientific worker tries to take into account all the previous work known to him and puts an overall final picture. This is particularly so when mention has been made of the previous work and no statement is made that an alternative picture is being presented. The mere mention of certain terms in a vague way does not prevent the same terms being used by a later worker after giving a *specific* character to the terms or ideas. There should be no possibility of mixing up meanings. It is desirable to give the background of work which led to the ideas.

In 1933-34, I had tried to study the equatorial circulation with the newly started pilot balloon observatories in Br. E. Africa. The observatories were within a few degrees of the equator and were, I thought, suitable for a study of transport of air across the equator. In north-

* Part of the Address at the Physics Symposium, Indian Science Congress, Patna, Jan. 1948.

ern summer, large southerly components could be found up to about 1·5 to 2·0 kms. at these places. The data from the Malayan Peninsula and from the Far East were also used. Unfortunately other duties prevented me from following up the ideas. While forecasting at Karachi (1938-42), I was distressed like most novices, at the large mass of disjointed facts apart from a few well-known ones. Among them were: "A western disturbance would, often, have passed away over Iraq according to prevalent ideas. But yet, Bahrein continued to record southeasterly or southerly winds and Bushire continued to record low pressure values and the value used to be very often corrected. During the summer, in the Persian Gulf region, instead of the usual "Col" pattern, a hexagonal pattern with three low pressure areas alternating with three high pressure areas existed almost daily. Simple ideas of axes could not be applied. The hexagonal pattern and the stationary type of the S.W. monsoon were apparently connected. There was hardly any detectable disturbance over Iraq; on the evening of 16h February 1939, the upper winds at about 2·0 kms. were 180° apart at Bahrein and Sharjah. Later a ship reported a southerly wind off Oman. The subsequent fortnight of bad weather with its air accidents were difficult to explain cogently. B. N. Banerji had given the idea of a secondary western disturbance. The fact that every western disturbance had to be divided up into a series of separate circulations, each of which could be supposed to have its own identity and evolution, was not on record. Fresh problems were posed when the observations from Iraq were cut off in 1940 due to disturbances there. By an analytical method of mixing up of cause and effect, the criteria for the production of dust-rising winds were determined. Sen's vortex method of weather forecasting appeared after 1942.[1] After I came to Poona in May 1942, the ideas that were represented on the charts did not agree with what I had gathered at Karachi for the same region. The security reasons prevented access to work elsewhere. Deppermann's pre-war work was available only at the end of 1946. Pendall's charts came slowly in batches after August 1943. Apart from this, observations from familiar places like Burma and Sumatra and from the ships were cut off and those from Russian Turkestan, new to us, obtained. In between Russian Turkestan and the frontiers of India the area was unrepresented. The maximum use had to be made of the data without waiting for the 'collection of statistics' or 'climatology'. *Ad hoc* methods were not in place. Fresh data would trickle in at any time and newer demands were made by the weather clients. It was very necessary to formulate some method of tackling the problem, and in a colloquium at Poona in January 1943, the "Basis of Tropical Meteorology" was given.[7]

The drawing of isobars or other isopleths in the tropics was the first problem. They had to belong to a non-intersecting family of curves. The pressure and wind at each place gave three quantities which went to solve the equations determining the members of the family. This advantage could not be sacrificed on the plea of uncertainty of observations or of their significance. Rules were formulated so that fairly reproducible curves could be drawn.

In the tropics, the disturbances are mostly diffuse. They have to be split up into individual circulations and followed step by step. The principle of minimum action was applied to the motion of depressions, which should have a preference to cross coast near the river deltas, valleys and to move in between the corridors of two high pressure areas. The idea of latitudinal convergence was applied to both streams and disturbances. A depression that had an *apparent* equator-ward travel and showed a *deepening* was definitely taken as composed of two depressions. The main depression moved as usual, polewards and a secondary depression had developed on the more equatorial side. The western disturbances and the typhoons that crossed over into the Indian area furnished the evidence for this concept.

The effect of a limited obstruction like a mountain or a high pressure ridge in the path of a depression of the same or bigger order of dimension was next considered. A secondary depression can often be induced on the other side of the obstruction even though the original one was deflected away polewards.

The principle of 'confusion or mixing up of cause and effect' was necessary in a continuous and uncontrollable process or series of experiments. The principle of superposition follows logically for a resynthesis of meteorological phenomena.

While it is hardly possible to write down the concrete steps in any but extremely general steps, yet the definite method of approach was a step forward. Obviously, any theory so formulated must lead to further verifiable results without an overloading of *ad hoc* assumptions. There must be an essential rational structure in tropical meteorology. The ideas were verified in a few typical cases. When they were found correct, newer logical consequences were deduced for further verification and in turn for further deductions. Due to inherent observational difficulties, it was realised that not all stages of argument could be verified. If, however, there was a definite contradiction in the course of the work, all assumptions were re-examined and suitably modified. The starting point was the ideas actually prevalent. This method saved time and gave the much needed results. When draft "Notes on Forecasting Weather Over India and the Neighbourhood" had to be written up in January 1943, the method allowed me to write up the book continuously (in a few weeks), as a series of connected facts. Any other method would have involved formidable work and inordinate delay. Soon after the observations from the Indian Ocean were charted (May 1943), the essentials of tropical depressions and of monsoon could be grasped.

The surface gradients of the measured elements in the tropics are small compared with their corresponding values in the temperate zones. If an attempt at air mass analysis has to be made distinctly and unmistakably, the tracing in space and time has to be from a far enough region from an actual depression. The sequence of meteorological phenomena is an important guide in following the air streams.

Mauritius used to send telegrams about cyclo-

nic storms in the S.W. Indian Ocean in the non-monsoon months up to the end of 1942. The concurrent weather over India was noted. The old ships' logs near the equator were also consulted. The weather near the equator was found to be significantly related a few days before the detection of formation of cyclonic storms on either side of the equator. Fresh monsoon air crossed the equator only at intervals and under only specified conditions. A definite time sequence was found and could be used for medium range weather forecasting.

In my experience the heat waves at Agra (1935-37) and at Karachi (1938-42) were followed by unsettled weather in the Bay of Bengal or in the Arabian Sea respectively. The time sequence was detectable.

Roy and Roy's idea of "deflected and desiccated monsoon air" was highly localised in space and time. It could not be used for a monsoon depression in the N.E. Arabian Sea. It could not be applied to even the depressions in the Bay of Bengal in the non-monsoon months. Often, the sequence of weather did not permit the time lag required for the monsoon air to get deflected. The potential wet bulb temperature of this 'deflected' air was greater than that of the fresh monsoon air so that the idea of desiccation is invalid. The application of this deflected and desiccated air, elsewhere in the tropics, was out of question. Sen and Puri's observations were confined practically to India and Burma. Little attempt was made to trace the air masses even by implication to high pressure areas. Deppermann found, sometimes, on the N.E. side of the typhoons a warm sector near the Philippines. His background of analysis is similar to that employed for extra-tropical depressions. My method of detection of this third air mass was based on a study of carefully drawn isobars, streamlines and on the sequence of weather. It came from the east and its temperature and humidity changed considerably with season and locality.

The monsoon depression and tropical cyclonic storms with a westward travel had the same structure and involved the incursion of three and only three air masses: (1) Fresh monsoon air or Equatorial Maritime air (Em) from the other side of the equator; (2) Far Eastern Transitional air (Tr) and (3) Dry Continental air (Tc and occasional Pc). The chief features of the three air masses are:

Equatorial Maritime Air (Em).—During the S.W. monsoon and in the pre- and post-monsoon months, fresh maritime air crosses the equator from the south at intervals depending on other specific meteorological conditions. The actual time taken to cross the equator is very small. There is a good interval of a few days before the next crossing can take place at or near the same locality. The word 'pulse' of monsoon was employed to indicate the discontinuous and short-period crossing of air from the southern hemisphere. The character of the air mass undergoes considerable change during its travel. It starts from one of the high pressure cells in the southern hemisphere as almost dry continental air (Tc). In its westward travel, it gradually picks up moisture and additions of dry air from further south. Later, due to its moisture content, it can be recognised as giving rise to shallow low pressure areas. Its vertical height is not more than 2 kms. It moves in an almost W. or W.N.W.-ly direction. The air at this stage corresponds to the Far Eastern Transitional or Mixed air (Tr) described later. As there is an equator-ward component in the motion of the shallow low pressure area, the air cannot be made easily unstable. It picks up considerable amount of moisture and temperature when moving over large water surfaces in the tropics. Being southern winter, the moisture content would be large only in the lower layers. Mid-air temperature inversions would be found at about 1·5 kms. As the shallow low pressure area or 'pulse' approaches the equator, the moisture content increases appreciably. When just about to cross and certainly after crossing the equator, the air would have accumulated a large amount of energy and the temperature inversion disappears. The equator acts as a sort of selective barrier which is not impassable. After crossing the equator and moving northwards, the air undergoes convergence due to pole-ward travel. *The air at this stage is Em.* It can be made easily unstable. Thunderstorms occur all along its path and the weather over the sea would be squally. The diurnal variation of temperature in its mass is small, hardly 2° to 3° F. The sea-level temperature is just under 80° F. In its northward travel, due to latitudinal convergence and due to its passing over the sea the vertical thickness of moisture increases and the energy is easily releasable. It acts as a 'source' among the tropical air masses.

Far Eastern Transitional or Mixed Air (Tr).—This is a mixture of Tropical Maritime air (Tm) and Tropical Continental air (Tc) in varying proportions depending on the locality and season. In the Pacific Ocean, there may be even a mixture of Em. In winter, over land area, there may also be Polar Continental air (Pc). The air comes to India from the same side of the equator as the depression; the ultimate origin of Tm is the high pressure area over the N. Pacific Ocean; and the high over N. Asia supplies Tc and in winter even some Pc. Tr flows along the 'N.E. Trades' in winter. In summer, it flows along the displaced 'N.E. Trades', displaced because of the vast low prssure area over Asia. Part of the air has an equator-ward travel and tends to develop stability in its mass and, as mentioned by Braak long ago, mid-air temperature inversions. Once the temperature inversion has developed, it is not sensibly affected by the slow drifting of air northwards round the anticyclonic cells. If the mid-air inversion is wiped out by rapid latitudinal convergence, bad weather and very heavy rain can result. Ordinarily it does not release energy, though it is hotter than Em in summer, both as regards the dry and wet bulb potential temperatures; and it passes very near the temperature and pressure equators. In the hills of N.E. India, it may produce some weather due to orography and due to any convergence. The word 'Transitional' is apt as the air undergoes all the stages in the transformation from Tc to Em in its travel from one of the high pressure cells upto its crossing the equator to the other side.

Tropical Land Air or Continental Air (Tc).— For India, it has mostly a land origin from lands in W. Asia. It can be described as Tc with an occasional mixture of Pc. Its humidity is small and it shows a large diurnal variation of temperature on the ground. It brings in unusually hot or unusually cold days over the regions where it passes. For depressions in E. Bay of Bengal or E. Arabian Sea it would be mixed with Tm or Tcm. It is unnecessary to have a separate classification: Equatorial Continental air (Ec), for hot dry air.

With an extensive weather chart, the various air masses can be separated and studied. In the case of the S. hemisphere, an obvious interchange of words 'north to south' and *vice versa* in the above has to be carried out. The ideas are applicable to any part of the tropics.

An important point has to be stressed. The three air streams may be in juxtaposition very near the tropical depression. But earlier to the formation of, and further away from the location of the depression, between every two infeeding streams there is a sort of stagnant air which can at best be described as 'mixed'. The larger circulation due to the tropical depressions may affect the 'mixed' air. If the latter is moist enough, in the 'larger' field of circulation of the depression there would be precipitation whenever there is convergence due to latitude or otherwise. It is possible to mistake this 'mixed' air as the main moist stream of the depression and follow it. One of the most important areas where the 'mixed' air occurs near India is in Central and East Arabian Sea. The West Arabian Sea has Tc from Africa. Before the formation of a monsoon depression at the head of the Bay of Bengal, the track of thunderstorms is from the S.E. Madras to Orissa coast. But with the formation of a monsoon depression in the N.W. angle of the Bay of Bengal, places like Poona get continuous rain. The west coast may get rain as far north as Dahanu, north of Bombay. Within a very short time after the Bay depression has crossed coast, sometimes as short as half an hour, the rain stops at Poona and often even along the N. Konkan coast. Rain along the west coast of India and the rain at Poona are *not followed*, after a definite number of days by a depression at the head of the Bay of Bengal. It appears that the rain along the west coast and at Poona must be due to convergence in the 'mixed' air due to the larger circulation of the Bay depression and perhaps orography. The rain near Gulbarga, Bangalore or Kodaikanal when there are depressions at corresponding latitudes in the Bay must have similar explanation. Pisharoty[8] found the distance between two convergent areas due to change in latitude of an air stream applying Holmboe's theory. The distance from Poona to the head of the Bay of Bengal was of the right order. If the 'mixed' air in the Arabian Sea is not moist enough or if the amount of convergence is insufficient, rain may not fall along the west coast with a depression at the head of the Bay. It is easy to explain the temperature structure of the air stream on the rainy days and the simultaneous onset of the monsoon rain throughout the west coast. The type of rain associated with a depression in the N.E. angle of the Arabian Sea has much more of a creep along the west coast. The other 'mixed' air which needs to be taken into account is the Tr which has approached the equator, which is deflected back due to some reason and which undergoes sufficient latitudinal convergence. Its property would be very similar to Em. A plea may be put forward that the bent-back Tr from the equatorial regions or the 'mixed' air from the Arabian Sea may sometimes be the monsoon feeds of a tropical depression. The over-all sequence of weather phenomena and the reaction of weather in the northern tropics when there is a tropical depression south of the equator in the same longitudinal sector are strong arguments against the plea.

It was found that after a tropical depression recurved eastwards, it had only two sectors and had only two air masses.[9] The air masses could be designated as Tm or Tcm and Tc with an occasional mixture of Pc. The depression resembled the extra-tropical ones. When Em was absent, the depression had an eastward motion. A rigorous convention can be established that a depression is strictly tropical when all the three air masses including Em are present and has, therefore, a westward movement. The depression is to all purposes extra-tropical in structure when only two air masses are involved and has an eastward tendency of motion. Before the actual change of directions takes place the previous momentum of the depression as an entity should be taken into account. Nearer the equator, after a depression has recurved eastwards, it may again get an infeed of Em and once more move westwards. This occurs sometimes and makes a depression change its course unexpectedly from some N.E.-ly direction to some N.W.-ly direction in the Indian area.

Low pressure areas or diffuse disturbances, however, travel in either direction according to the motion of the 6 km. winds in the 'source' sector.

The western disturbance could be split up into simpler circulations or secondary low pressure areas. Each of these had a distinct and evolution.[10] Each of them moved in a well-ordered way almost E.N.E.-wards. The weather at a place was a resultant of the effects of the simple lows. The seasonal low pressure area in winter is south of the equator and modifies the secondary lows of the western disturbance particularly in the more southerly latitudes of the northern hemisphere. The strength of the westerly winds at higher levels decreases as the equator is approached. Each secondary low pressure area of the western disturbance travels slower and extends vertically to a lesser height than its immediate northern primary. Outside the coast of the Persian Gulf and Oman, there were hardly any series of observations. This and the slower travel of the more southerly secondary depressions gave a faulty impression of S.E.-ly travel of western disturbances in the Gulf. The detailed analysis is consistent with known facts.

During the course of the work, a very fundamental result was found regarding the weather in one hemisphere when there is simultaneously a tropical depression in the other in a small sector of longitude. It was found that two tropical depressions, both moving in a westward direction, could not for long coexist on either side of the equator when the longitudinal sepa-

ration was small, about 10°. In winter, the existence of a similar tropical depression in the S. Indian Ocean gave dry weather over N.W. and Central India even if western disturbances passed over India. During the S.W. monsoon, a 'break' occurs if a monsoon 'pulse' does not cross into the Indian region and moves away westwards or if no 'pulse' appears south of the equator. The first would happen if there be a tropical depression in the S. Indian Ocean. The southern depression may give rain in the extreme south Peninsula within about 12° of the equator. It follows that whatever be the season, outside 10° or 12° of the equator, the weather over a greater portion of India would be generally dry if there be a tropical depression in the S. Indian Ocean. Though tentative dynamical reasons were given to account for the effects,[10] the facts have been verified. In general it follows that the weather would mostly be dry in a latitudinal belt between 12° and 30° of the equator and a longitudinal sector of

(b) one of the tropical depressions may fill up and the other may continue on its westward journey;

(c) one of the tropical depressions may recurve under the influence of an extra-tropical depression and the other tropical depression may continue its westward journey;

(d) Both the tropical depressions may recurve after they have moved away from the equator under the influence of extra-tropical depressions or their secondaries.

The strength of the easterlies at 6 kms. near the equator is smaller than the strength of the westerlies away from the equator. Under similar conditions, an extra-tropical depression moves much faster than a tropical depression. As a rule, the rate of latitudinal shift is also similar. Hence, a recurved tropical depression must normally be more severe than it was before recurvature. If, however, under category

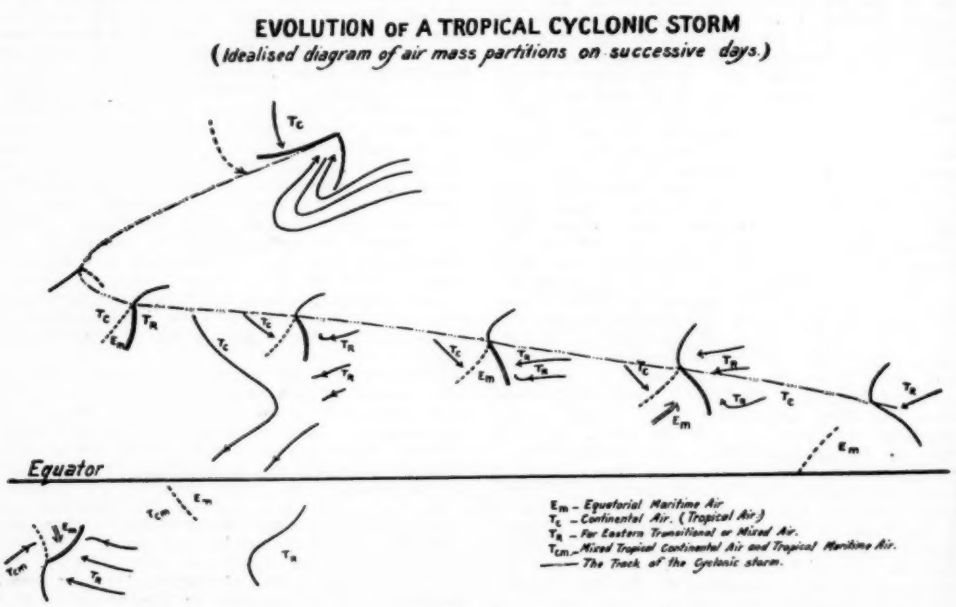


FIG. 1

15° to 20°, whenever there is a tropical depression in the other hemisphere moving in a westward direction. This rule can be used with benefit over the Pacific Ocean and over Australia. As a counterpart, when the 'Trades' fed into an extra-tropical depression, the latter would be more active than usual. A recurved tropical cyclonic storm is an extreme case of this.[10]

As two tropical depressions cannot co-exist for long on either side of the equator within a small longitudinal sector, four distinct possibilities can occur:

(a) Both the tropical depressions may fill up, particulary if they are fairly near the equator;

(c) there is a tropical depression on the other side of the equator, the recurved tropical depression does not get to be severe soon after recurvature. The problem is similar to a western disturbance with a tropical depression on the other side of the equator. After the separation between the recurved depression and the westward moving tropical depression has become large enough in longitude, the former, if it still exists, has a chance of getting severe (see idealised figure).

More popular conclusions would be the partial explanations of "Why is a major portion of India dry in winter?", "Why is Australia drier than India?" and of the distribution of arid zones on either side of the equator. The deve-

lopment of high pressure belts, during the winter, may also be explained.

The application to medium-long range forecasting on a synoptic basis is implicit in the above. The most important air mass Em was traced from the northern side of the high pressure area in S. America. Its travel south of the equator to the north of the seasonal high pressure belt was modified by several meteorological conditions till it finally moved into the N. Indian Ocean. A good climatic chart showed what the factors would be and these provided the long-sought for physical explanation of centres of action determined statistically by Walker. To further verify the ideas, the analogous case of the southern monsoon was traced from the southern side of the winter high pressure area over N. America and the modifying factors found. Rain in N.W. India being adversely affected by southern depression, it should be negatively correlated with the southern monsoon and hence with the high pressure on the south-west side of the winter N. American high after a definite time lag. With data extending over 75 years, the value of the correlation coefficient was $-0{\cdot}38$: a significant value.[11] This factor had not been used earlier and hence was a critical one. The role of Tc and of Tr in medium-range forecasting was also determined. The method of analysis of a western disturbance and the differential rates of travel and evolution of the secondaries, when Tr fed into them or away from them, were directly usable.

The question of 'heat' and 'frontal' thunderstorms was tackled. In the case of 'frontal' thunderstorms, there is an appreciable fall in the wet bulb temperature. With the help of analysed western disturbances, where the secondary travels slower and extends to a lesser vertical height than its northern primary, a simple explanation of the fall in the wet bulb temperature could be given without invoking the descent of air from 4 to 6 kms. Heat thunderstorms were looked into. Taking account of the daily variations in the high pressure belts in upper air at about 2 kms. on either side of the equator, the thunderstorms that occur on the pole-ward side of the belt are of 'frontal' type and those that occur in the equatorial side of 'heat' type.[12] Tornadoes that sometimes accompany 'frontal' thunderstorms cannot, therefore, occur in the tropics.

The application of the above methods have been helpful in understanding tropical weather in a rational way, and many problems can be explained satisfactorily.

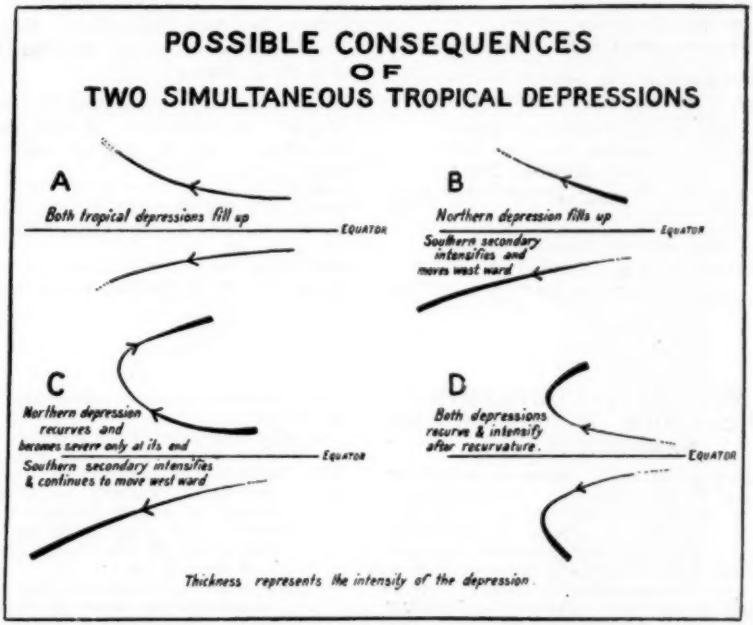


FIG. 2

1. The references are found in *Curr. Sci.*, **1947, 16,** 177, and Hemraj, *The Imperial Gazetteer of India*, **1907, 1,** 3. Doraiswamy Iyer, see below. 2. Doraiswamy Iyer, 'Rainfall in Siam, *Sci.' Notes Ind. Met. Dept.*, **1931, 4,** 69. 3. Wagner, *Gerl. Beitr. z. Geophys.*, **1931, 30,** 196. 4. Doraiswamy Iyer, *Mem. Ind. Met. Dept.*, **26,** 93. 5. Ramanathan and Ramakrishnan., *Mem. Ind. Met. Dept.*, **1932, 26,** 13 and Sur *ibid.* 37. 6. Ramanathan and Ramakrishnan, *ibid.*, **1938, 189** (reprinted text, **1943**), 7. Malurkar, *Proc. Ind. Acad., Sci., Bangalore.*, **1947, 25,** 297. 8 Pisharoty, announced in *Symposium Nat. Inst. Sci. (India)*, Sept **1946.** 9. Malurkar, *Curr. Sci.*, **1947. 16,** 14. 10. Malurkar., *ibid.*, **139.** 11. Malurkar, *ibid.*, 77. 12. Malurkar, " Winter Rain in the United Provinces and Norwesters in Bengal;" Malurkar, "Mechanisms of Thunderstorms in the Tropics" (MSS. unprinted yet).

Note.—The cost of printing this article has been met from a generous grant received from the National Institute of Sciences, India.

LETTERS TO THE EDITOR

DIRECT VOLUMETRIC DETERMINATION OF CALCIUM IN PRESENCE OF MAGNESIUM

The determination of small amounts of Calcium in presence of large amounts of magnesium is a problem of considerable difficulty. The oxalate method for calcium yields a precipitate contaminated with magnesium oxalate and special procedures have, therefore, to be employed. Kuchment and Gengrinovich[1] recently introduced a method of direct titration of calcium with sodium oxalate in presence of cacotheline and ferrous ions which yielded a violent endpoint. These authors claimed that calcium could be rapidly determined (1-2 minutes) in presence of magnesium, at least five times the quantity of calcium, in acetic acid medium with an accuracy of $\pm 0{\cdot}15$ to $\pm 0{\cdot}67$ per cent., and a higher degree of accuracy using a blank correction. The colour of the end-point is stated to be due to the reduction of cacotheline by the ferrous ions when oxalate ions are present to react with the ferric ions.

In an investigation dealing with the recovery of magnesia from dolomite, a rapid method for the determination of progressively diminishing quantities of lime in presence of relatively large amounts of magnesium was required and at first sight, the above method appeared to be promising. On investigation, however, it was found that there were several complicating factors and the results of Kuchment and Gengrinovich[1] were not fully corroborated.

The present author's observations were as follows:—

(*a*) The end-point in a neutral solution was blue and only in acid solutions, violet;
(*b*) the colour as well as the stability at the end-point depends on acidity the increase of which reduced the stability;
(*c*) Acidity was also a factor determining the value of the blank on cacotheline and ferrous ions;
(*d*) the reactions leading to the colour of the end-point are slow so that an appreciable interval exists between the addition of oxalate and full development of colour; and
(*e*) it was generally observed that the end-point was hardly stable for one minute and although the time lag was sufficient for noting it, a greater stability would be a desideratum for a good analytical method.

In actual determinations of calcium it was found that the acid concentration (acetic acid) is very important. If neutral the end-point is blue, if weakly acidic the colour is violet, but the end-point is not clear. With 0·5 c.c. of acetic acid in a volume of 50 c.c. good endpoints were obtained for amounts of calcium ranging from 100 to 60 mg. At the same acid concentration, with smaller amounts of calcium the end-points were obtained too soon and the errors were very high; when the acid concentration was increased to 1 c.c. per 50 c.c., similar difficulties were experienced in all cases.

With an acidity of 1·0 c.c. of acetic acid per 50 c.c. of total volume of a mixture of calcium and magnesium, good results were obtained only up to a magnesia content twice that of lime.

The above experiments were carried out with a B.D.H. sample of cacotheline for "Spot Tests" and neutral solutions of calcium and magnesium chlorides. A neutral aqueous solution of ferrous ammonium sulphate was used to supply ferrous ions.

Fuller details will be published elsewhere. The author wishes to thank Dr. K. Neelakantam for his kind interest in the work.

Dept. of Chemical Technology,
Andhra University,
March 9, 1948. A. VENKATESWARLU.

1. Kuchment and Gengrinovich, *Chem. Abs.*, 1946, 1412; *Analyst*, 1947, **72**, 492.

FAR ULTRA-VIOLET EMISSION BANDS OF PHOSPHORUS

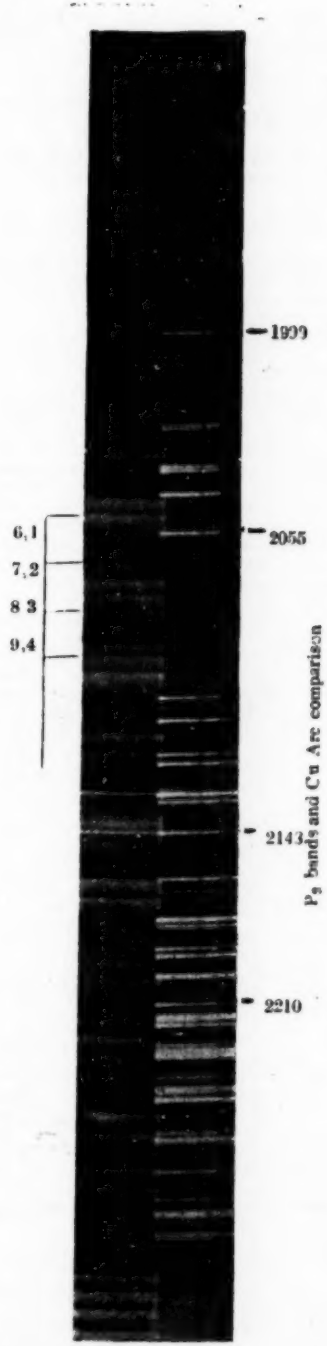
OUR knowledge of the extensive ultra-violet band system ($^1\Sigma^+_u \rightarrow {}^1\Sigma^+_g$) of the P_2 molecule and its vibrational structure is due to Jakowlewa[1] who studied the system in absorption. Herzberg[2] investigated the same system in emission but reported only bands involving the ground state levels from $v''=4$ to $v''=32$. No bands were recorded arising from levels v'' less than 4.

Excitation of the band spectrum using a High Frequency Oscillatory discharge through heated phosphorus vapour with external electrodes gave a fairly intense system down to λ 1940 (*cf.* Fig. A). About 50 bands are newly recorded *in emission* having the ground state levels $v''=0$ to 4. The classification of these and their wave-length data are given in the following table.

TABLE I

Wave-length	Int.	Classification (v', v'')	Wave-length	Int.	Classification (v', v'')
1949·5 ..	0	10,0	2108·4	1	3 1
62·9* ..	0	11,1	11·5*	2	8,4
83·3 ..	0	8,0	16·4	4	6,3
93·0* ..	1	11,2	22·5	2	4 2
2000·4 ..	1	7.0	35·1	0	0.0
09·8* ..	1	10.2	39·9*	2	10,6
17·9 ..	1	6,0	43·3	2	3 2
24·3 ..	1	11 3	45 5*	3	8,5
27·7* ..	1	9,2	51·5	0	1,1
32·2 ..	1	7,1	52·5*	1	6,4
33·1* ..	2		53·5*	1	11,7
42·1 ..	1	10,3	59·4*	2	
45·6* ..	2	8,2	60·9*	?	9,6
50·2 .	1	6,1	64·0	0	2,2
55·1 ..	1	4,0	79·1	1	3,3
64·7 ..	2	7,2	86·6	2	1,2
69·1 ..	2	5,1	88·8	3	6,5
73·9 ..	2	3,0	93·3	2	4,4
78·3* ..	1	8,3	95·3*	3	9,7
88·4 ..	2	4,1	2200·6	4	2,3
92·1* ..	2	9,4	09·3	2	0,2
97·1 ..	3	7,3	15·7*	4	3,4

Band heads observed only in emission; not obtained by Jakowlewa in absorption.



In addition to the above system, Herzberg mentions another brief system consisting of five

bands from λ 3970 to λ 4230, ascribed to the P_2 molecule. These bands are not observed on our plates.

Andhra University,
Waltair, K. SREERAMAMURTY.
March 19, 1948.

1. Jakowlewa, *Zeits. f. Phys.*, 1931, **69**, 548. 2. Herzberg, *Ann. der Phys.*, 1932, **15**, 677.

WINTER RAIN IN SOUTH INDIA

THE weather in South India in the winter period of mid-January to March is characterised by occasional outbreaks of thunder rain, the onset of which is rather sudden and occurs in the early part of the day. These spells of rain are of the N.E. monsoon type[1] and do not disclose themselves sufficiently in advance on the usual synoptic charts. Tephigrams of Madras, analysed in the manner recently suggested by Schell,[2] have been found by the author[3] to be of considerable forecasting value; but their usefulness is confined to the forecasting of the *local* weather only and that too within a few hours of the atmospheric sounding. Experience of the author at Madras has shown that Isentropic Charts give useful and reliable clues to anticipating spells of such rain in South India well in advance. A typical instance of such usefulness of isentropic charts is reported here.

There was a spell of thunderstorm rain in South India from the midnight of the 14th March 1946 till the evening of the 18th. This followed a protracted period of absolutely dry weather. Widespread and locally heavy rain occurred in the Peninsula south of the latitude of Madras (and also in Ceylon) on the 15th and the 16th. The area of precipitation gradually moved away westwards, until the weather became practically dry again by the evening of the 18th.

The earlier synoptic situation did not yield any clue to this spell of rain. The skies were almost clear everywhere even as late as on the evening of the 14th. But by the morning of the next day, the skies in the S.E. Madras area were nearly overcast with Cb, Fb, As and Ns. There were no significant pressure changes till the morning of the 15th. The upper winds were more or less normal throughout the above period.

The isentropic chart of the 13th evening at the 310° A level is shown in Fig. 1. The station model adopted for representing the isentropic data is as follows:

(X) Actual mixing-ratio ○ pressure (P)
(X_c) Saturation mixing-ratio condensation Pressure (P_c)

Isobars are drawn on this chart at intervals of 50 mb. as continuous lines and isohygrics at intervals of 2 gm./kgm. as broken lines. The contour of the isentropic chart, as delineated by the isobars, shows the existence of an isentropic "hill" with its apex over the Comorin area. The earlier isentropic charts showed a gradual concentration of the seasonal moist tongue in the South Bay. It advected westwards and invaded the whole of S.E. Madras by the evening of the 13th. The atmospheric cross-sections, not shown here, revealed that the moist tongue extended vertically up to a height of 15,000 ft. The winds on the isentropic chart in Fig. 1 have a considerable cross-isobar component.

The axis of the moist tongue lies between Madras and Colombo, which are thus on its opposite peripheries. Even at these places, we find the "lift" required for condensation to be about 100 mb., as shown by the intervals between *P* and *Pc*. The lift would, therefore, be much less near the axis of the moist tongue and may well have been under 50 mb. there. The westward advection of the moist tongue would result in its moving up-slope on the

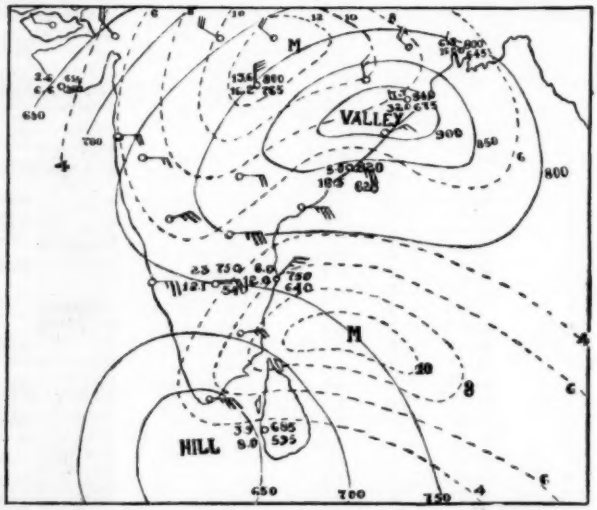
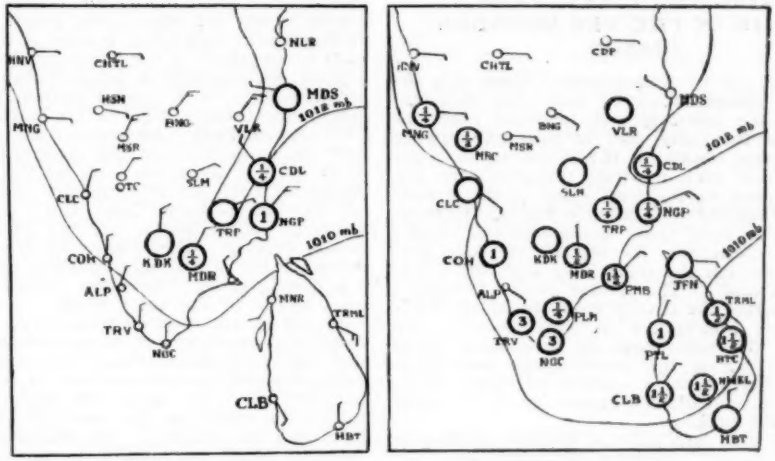


FIG. 1. Isentropic Chart (310° A) for 1700 Hrs. I. S. T. on 13-3-1946.

movement, as shown by the winds, is of the order of 15-20. m.p.h., one could reasonably expect it to invade the rest of South India within the following 24 to 36 hours. Its moistest axial regions could then come over S.E. Madras by the morning of the 15th. A subsequent westward movement of the moist tongue



Date: 15-3-1 946 Date : 16-3-1946

FIG. 2. Weather Map for 0800 Hrs. I. S. T.

could be expected to result in the westward extension of the area of precipitation. The isentropic chart thus shows that conditions were sufficiently favourable for the occurrence of precipitation over S.E. Madras by the morning of the 15th.

The weather subsequently realised on the 15th and 16th is shown in Fig. 2. All places where any sizable precipitation occurred are indicated in this figure by encircling them. The circles around places where the fall of rain was less than ¼" are left blank. Where the amount exceeded ¼", the rounded amounts are charted inside the circle. The surface winds and the isobars are also shown on this chart. These charts fully bear out the arguments set forth in the above paragraphs. It will be noticed that the areas where the heaviest fall of rain occurred by the morning of the 16th are in the extreme south of the Peninsula with lighter falls of rain to the north and south. This is because the steepest up-slope movement as well as the highest concentration of moisture in the moist tongue obtained in that area. The greater intensity of the precipitation in the southern as compared with the northern parts of the moist tongue is due to the existence of the isentropic hill over the Comorin area.

Details are being published elsewhere.

The author's thanks are due to Mr. B. N. Sreenivasaiah, Meteorologist, Madras, for his kind interest in the work.

Meteorological Office,
St. Thomas' Mount,
Madras, D. VENKATESWARA RAO.
February 15, 1948.

1. Sreenivasaiah. B. N., 1946, *Technical Note No.* **23**, *India Meteorological Department*. 2. Schell, I. I., *Bull., Amer. Met. Soc.*, 1946, **27**, 164. Venkateswara Rao, D , "Precipitation Index and Subsequent Rainfall at Madras", Under publicalion as a *Sci. Note, Ind. Met. Dept*.

BAND SPECTRUM OF THALLIUM IODIDE

EXCITING the vapour of Thallium Iodide by a low power high frequency oscillator, a characteristic band spectrum ascribed to the diatomic molecule, Thallium Iodide, was obtained extending from λ 5300 to λ 3750, the wavelength region between the two components $^2P - {}^2S$ of the Thallium arc. The bands are generally headless but some of them are red degraded. Over a wide range, they occur in well-separated groups, each consisting of about 4 or 5 equispaced components with an interval of about 28 wave-number units. Each group presents a maximum and then a gradual falling off in intensity, indicating a clear sequence structure. By comparison with the corresponding spectra of the other related halide molecules (In, Hg, etc.), these bands are interpreted as forming two overlapping systems due to the transitions $^3O^+ \rightarrow {}^1\Sigma^+$ and $^3I \rightarrow {}^1\Sigma^+$; the vibrational frequency ω''_e of the common ground state is derived to be approximately 122 cm.$^{-1}$, the anharmonic constant being negligibly small. The frequency ω'_e corresponding to the state of $^3O^+$ is approximately 94 cm.$^{-1}$

A third brief system is also obtained between λ 3680-λ 3600 consisting of three or perhaps four continuous patches superposed by distinct sequences of bands separated by the same wave-number interval of about 28 units. The lower state of this system is considered to be the same as that of the above systems.

Details of the analysis will be published elsewhere.

Andhra University, P. TIRUVENGANNA RAO.
Waltair, K. R. RAO.
March 31, 1948.

MORNING THUNDERSTORMS AT COCHIN IN THE PRE-MONSOON SEASON

As pointed out by Sreenivasiah,[1] there is a remarkable concentration of rain and thunderstorm in the morning and forenoon hours at Madras in the early part of the withdrawing S.W. monsoon season. It is also the author's experience that such morning thunderstorms are very frequent on the west coast of the Peninsula, for example at Cochin, in the pre-monsoon months. In both cases, cumulonimbus clouds, as a rule, form over the sea off the coast and advance towards the coast later with the winds prevailing aloft. The nature of the "trigger", which releases the energy from the conditionally unstable atmosphere in such cases is still obscure. The notes kept by the author while at Cochin during the pre-monsoon months in the year 1944, when a number of radar observations were available, appear to throw some light on the problem.

All the data available at Cochin relating to the pre-monsoon morning thunderstorms are shown in Table I below. The place from where the radar observations were made was Eddappilli, about 10 miles to the N.E. of Cochin. The times given under column 2 are those of location of the active thunderstorms by the radar. The ranges of the storm centres from the coast and their bearings with respect to the place of observation are given in the next two columns. The data in the last two columns are the observations made at 09.00 hrs. I.S.T. at the Cochin Observatory.[2] Though the wind on the 20th at the Observatory was calm at 09.00 hrs., it was N.E. at the pibal station at Willingdon Island, which is a little to the east of Cochin. Also, at 09.00 hrs., moderate continuous rain was in progress at the Observatory. The current weather observations made at the pibal station also showed that the land breeze persisted from about 02.00 hrs. to 12.00 hrs. on all the days; and there was no shift in the wind direction until the thunderclouds came overhead.

TABLE I

Date	Time in I.S.T.	Range in miles	Bearing in deg.	Surface wind	Minimum temp. in °F.
9-5-1944 ..	1115	43-46	255	ENE	77
11-5-1944 ..	0601	25-35	230	ENE	74
20-5-1944 ..	0858	8-11	227	Calm	75
29-5-1944 ..	1125	42-52	305	SE	77
29-5-1944 ..	1235	35-45	307	SE	77

It is seen from the above table that the bearing of the centre of the thunderstorm on the various days is just opposite to the direction of the surface wind at the time. This is significant because the surface wind on all those occasions was the relatively cool land breeze, which generally extends vertically up to 2,000-3,000 feet and horizontally beyond the coast up to 30-40 miles, depending on its strength. Owing to its thermal contrast from the seasonal winds, the land breeze would act like a cold front. The prevailing moist westerlies ensure a higher wet-bulb temperature in the lower levels and create a thick environment of latent instability. This is particularly so at coastal stations where dew points are usually high in the surface layers. This environment commences from about 2,000 feet, as borne out by the observed height of cloud base. Hence, as soon as the advancing wedge of cold air lifts up the surface layers of the atmosphere into this environment, vigorous convection is set up, and thunderclouds develop. The trigger for the release of energy in the atmosphere resulting in the morning thunderstorms, therefore, seems to be the land breeze at the coast itself.

It will also be noticed from Table I, that the time of commencement of the thunderstorm as well as the distance from the coast where it forms depend on the magnitude of the minimum temperature. The lower the minimum temperature the closer to the coast do these clouds form and the earlier in the morning. This inference would be helpful in anticipating the time of occurrence of these thunderstorms. As the nocturnal cooling of the ground layers of the atmosphere determines the value of the minimum temperature, the clearer the skies at night, the earlier can the thunder-clouds be expected to develop. The probable isobaric situation towards the morning hours must, of course, be taken into account in deciding upon the nature of the land breeze. Katabatic winds, if present, and the cooling of the ground layers of the atmosphere due to past precipitation would augment the effect of the land breeze.

The author's thanks are due to Mr. B. N. Sreenivasaiah, Meteorologist, Madras, for his kind interest in the work.

Meteorological Office,
St. Thomas Mount,
Madras, C. A. GEORGE.
February 20, 1948.

1. Sreenivasaiah, B.N., *Some Features of Madras Weather*, Technical Note No. 23. India Meteorological Department. 2. *Indian Daily Weather Report*, May 1944, India Meteorological Department.

OBSERVATIONS ON NITRITE-PRODUCING BACTERIA FROM DIFFERENT SOURCES AND THE ROLE OF PROTOZOA IN NITRIFICATION

DURING recent years, there has been increasing evidence to show that, apart from the special forms of nitrifying bacteria (species of *Nitrosomonas* and *Nitrosococcus*), there are other types of bacteria commonly occurring in soil and other systems which are capable of producing nitrite fro mammonium salts.[1-3] We have carried out some studies on the occurrence and distribution of nitrite-forming bacteria in natural systems, such as water, sewage, soil and compost, and also on the extent of their activity in these media. The nitrifying activity of these bacteria, individually and collectively, as also in presence of certain forms of protozoa (*Vorticella* sp. and *Epistylis* sp.) which have been

found to influence nitrification in Activated Sludge,[4,5] has also been studied.

Out of the eighty-one different strains of bacteria isolated on nutrient agar and other media from samples of water, soil, sewage, compost and fæces of animals (the bacteria characterised according to Bergey[6]), thirty-seven were found to produce nitrite (sixteen of these produced only traces of nitrite) in aqueous suspensions of soil, sewage and compost materials. The observations on the nitrite-forming bacteria and the amounts of nitrite produced by the different bacteria, singly and in combination, as also the influence of protozoa on nitrification are given in Tables I and II. The effect of addition of small amounts of Activated Sludge and septic tank sludge on nitrification in the medium was also studied.

Nitrification in aerated sewage and other media was found to start only after the flocculation of the suspended and colloidal matter in the media: formation of nitrite was found to proceed after aeration for 24 to 72 hours, largely depending upon the nature and concentration of the organic matter and the inoculum; and production of nitrate was found to take place as the aeration was prolonged after 72 to 96 hours.

The observations given in Tables I & II show that the nitrite-producing bacteria are commonly distributed in nature and that the amounts of nitrite produced by the bacteria alone, singly or all together, are less than those formed in presence of certain forms of protozoa, such as the *Vorticellids* occurring in Activated Sludge.

TABLE I

Extent of nitrite production by the individual strains of bacteria from different sources, with and without Vorticella *sp. (after aeration of the medium for 96 hours)*

Sources examined	No. of different strains of bacteria isolated	Media employed for the nitrification test (800 c.c.)	No. of nitrite-formers observed	Nitrite produced (p.p.m.)	Nitrite produced by bacteria in presence of *Vorticella* sp. (p.p.m.)
River water ..	2	Sterilised sewage	1	0·06	2·50
Tank water ..	6	,,	5	traces to 0·08	0·2 to 3·0
Borewell water ..	3	,,	2	traces to 0·08	0·25 to 1·50
Garden soil ..	6	Sterilised soil suspension	1	traces	0·35 to 0·60
Compost heaps ..	13	Sterilised compost extract	2	traces to 0·04	0·12 to 2·0
Raw sewage ..	3	Sterilised sewage	1	0·04	0·06 to 0·08
Septic tank sludge ..	2	,,	1	0·04	0·08
Activated sludge ..	3	,,	3	0·04	0·12 to 0·20
Cow dung ..	7	,,	3	traces to 0·04	0·08 to 0·12
Horse dung ..	8	,,	2	traces	0·25 to 3·0
Fæces of rat, rabbit, dog and monkey	28	,,	16	traces to 0·06	0·07 to 3·80

1. c.c. of active bacterial culture was used as inoculum in each case; the protozoan inoculum contained about 20,000 active cells of *Vorticella* sp.

TABLE II

Effect of addition of mixed cultures of bacteria, protozoa, and sludges to suspension of soil, sewage and compost on nitrification in the medium (after 96 hours' aeration)

Treatments (in each case 2 litres of sterilised suspension of soil and compost extracts and sewage mixed in the proportion of 1 : 1 : 1)	Nitrite nitrogen (p.p.m.)	Nitrate nitrogen (p.p.m.)
Mixed cultures of all the 81 strains of bacteria	0·04	Nil
Washed cells of *Vorticella* sp. ..	0·40	traces
Washed cells of *Epistylis* sp. ..	1·80	0·80
Activated sludge ..	2·50	traces
Septic sludge ..	0·30	Nil

The percentages of nitrification by the bacteria associated with the protozoa and in the sludges were found comparatively negligible; the number of active protozoa in the protozoan inocula and in the activated sludge introduced was about 22,000 in each case; the septic sludge also contained a corresponding number of protozoa including *Vorticella* sp. but mostly in the form of cysts which on aeration became active.

Department of Biochemistry, Indian Institute of Science, Bangalore, *December* 30, 1947.

S. C. PILLAI.
T. K. WADHWANI.
M. I. GURBAXANI.
V. SUBRAHMANYAN.

1. Cutler, D. W., and Mukerji, B. K., *Proc. Roy. Soc.*, **1931, B 108, 384.** 2. Winogradsky, H., *Ann. Inst. Pasteur*, **1933, 50, 350.** 3. Russell, E. J., 'Soil conditions and plant growth,' 1937, Longmans, Green & Co., 369. 4. Pillai, S. C., *Ind. Med. Gazette*, **1942, 77,** 118. 5. Pillai, S. C., and Subrahmanyan, V., *Nature*, **1942, 150,** 525. 6. Bergey, D. H. *et al.*, 'Manual of Determinative bacteriology', 1939, Baltimore.

INFLUENCE OF HEAT ON THE PHYSICO-CHEMICAL PROPERTIES OF GUM-ARABIC

GUM-ARABIC, an acid polysaccharide, is mainly a calcium salt of arabic acid,[1] the nucleus of which is aldobionic acid (galactose-glucuronic acid) to which sugar molecules of galactose, arabinose and methyl pentose are attached.

Gum-arabic (composition :—Pentosan 34·34 per cent.; Galactan 33·93 per cent.; moisture 15·53 per cent.; Ca 0·6459 per cent) when heated to 170° C., and then introduced into water swells up to a considerable extent, but does not dissolve ; and the gel thus formed is non-sticky. There is practically no change in the chemical composition of the gum on heating it from 100°-170° C. The insolubility of the gum at 170° C., can be explained to be due to complete dehydration. On dehydration some of the molecular groups approach so closely[2] that when they are again brought in contact with water, their attraction for water molecules or its ions is unable to separate them.

The viscosity of the gum solutions goes on increasing (the relative viscosity of 6 per cent. solutions of the gums heated to 100° and 150° C., being 3·780 and 5·898 respectively) as the gum is heated from 100°-150° C. The increase in viscosity is due to the increase in the imbibed water. Water appears to be oriented in a shell surrounding the gum micelles and thus the disperse phase becomes, highly solvated which results in the increase of viscosity. This view is further confirmed from the results of dilatometric experiments—in which the volume contraction is found to increase with the temperature to which the gum has been heated.

Action of NaOH on the gum heated to different temperatures was studied potentiometrically. The quantity of NaOH required for reaching the neutral point goes on increasing with the rise of temperature. The quantities of 0·02N NaOH required to neutralise the acidity of 2 gms. of heated gum to 110° C. and 170° C. are 4·55 and 14·3 c.c. respectively. The phenomenon is explained on the basis of difference between the ionisation of calcium and sodium arabates, and due to the different hydration of calcium and sodium ions as found by David R. Briggs.[3]

The full paper on the subject will be published elsewhere.

Chemical Laboratories, M. N. MOORJANI.
D. J. Sind College, C. S. NARWANI.
Karachi,
February 5, 1948.

1. Butler, C. L., *J. Amer. Chem Soc.*, 1929, **51**, 1519. 2. Alexander, J., *Ibid.*, 1921, 438. 3. David R. Briggs, *J. Phy. Chem.*, 1931, **35**, 1929.

EEFECT OF NITROGENOUS FERTILIZERS ON THE RESPIRATION RATE OF POTATO TUBERS

OVERHOLSER and Claypool[1] and Harding,[2] working with strawberry and apple respectively, recorded a higher respiratory activity in fruits from plants, manured with nitrogenous fertilizers as compared to the control. The author has studied the effect of nitrogenous fertilizers on the respiratory activity of potato tubers of the variety, Darjeeling Red, grown at the Agricultural College Farm, Benares Hindu University, during 1943-44 and fertilized with ammonium sulphate at 40 and 80 lbs. N per acre, applied before planting. Tubers of almost equal size from control and manured plots were collected and their respiratory activity studied. For determining the respiration rate of tubers, the usual method of drawing CO_2 through Pettenkofer tubes containing baryata water was followed. The quantity of CO_2 absorbed by baryta water was estimated by titrating against standard HCl and the indices of respiration were computed by reducing the values to the unit fresh weight of the experimental material. The effect of nitrogenous fertilizers on the respiration rate of the potato tubers is given below.

TABLE I

Carbon dioxide evolved (mg./gm. of tubers) per hour at 30° C. in tubers

Days after planting	Control	Manured Plot	
		40 lb. N. per acre	80 lb. N. per acre
		Mean values	
64 ..	0·134	0·207	0·327
78 ..	0·122	0·252	0·327
92 ..	0·164	0·245	0·314
103 ..	0·160	0·214	0·262

It will be noted that the tubers obtained from the manured plots showed a higher rate of respiration at all the stages of tuber development. Sircar[3] also found that potato discs on absorption of ammonium nitrate showed an increased respiration rate.

It is generally believed that the material with a higher respiration rate has a poor keeping quality, and this was confirmed when the greater losses during storage were recorded with the tubers from the manured plots of this experiment.[4]

I am thankful to Prof. K. Kumar of Benares Hindu University, for helping me in the preparation of this note.

Department of Botany,
University of Delhi, S. L. TANDON.
February 20, 1948.

1. Overholser, F. L., and Claypool, L. L., *Proc. Amer. Soc. Hort. Sci.*, 1931, **28**, 220. 2. Harding, P. L., *Iowa Sta. Tech. Bull.*, 1935, **182**, 313. 3. Sircar, S. M., *Indian J. Agric. Sci*, 1943, **13**, 382. 4. Kumar, K., and Tandon, S. L., *Curr. Sci.*, 1946, **15**, 318.

SETT ROOTS IN SUGARCANE

SUGARCANE is vegetatively propagated by planting setts. At every node above the leaf-joint there is a region of root-initials (keimring). When setts are planted in the field, roots develop from these root-initials, and these are termed "sett roots", in contrast to the roots that develop from the sprouted bud at the same node and which are called "shoot-roots". Barber[1] and Venkataraman *et al.*[2] emphasized the importance of sett roots for the full development of the bud into a shoot. That the sett roots function only temporarily in the early stages and that the shoot-roots replace them have also been pointed out by the same authors.

By anatomical studies in this laboratory, it was noted that the buds are more intimately connected with the inner storage tissues of the sett while the sett roots are more superficial. It was also noted under a variety of field as well as laboratory conditions that the bud could sprout and grow while the root-initials are dormant. These two facts led us to re-investigate the importance of sett roots in the early stages of germination in cane setts.

The root-initials were artificially removed with a scalpel, and the setts were planted both in pots and in the field. The buds sprouted normally (Fig. 1) and the seedlings developed

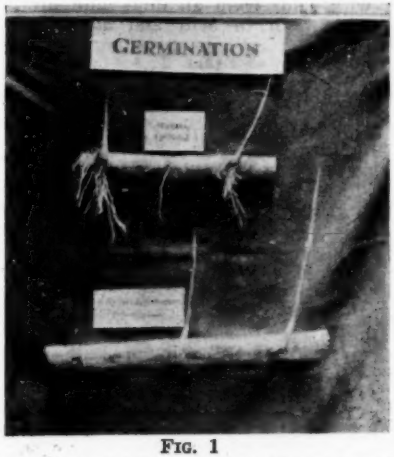


FIG. 1

FIG. 2

into normal crop (Fig. 2). Preliminary studies in these two types of treatments (normal and setts without nodal root-initials) revealed some possible physiological consequences as already indicated by Barber and Venkataraman *et al.* (*loc. cit.*). The absence of sett roots does not affect germination (*vide* Table I) because the sett has already enough moisture and reserve food readily available and accessible to the bud.

TABLE I

Character		Normal	Root-initials removed
Germination %			
10 days	..	43·3	38·5
20 days	..	50·2	50·6
30 days	..	50·9	51·1
40 days	..	50·9	51·1
Tillers/Bud :—			
After 5 weeks	..	1·19	1·67
After 4 months	..	2·40	2·70
Height :—			
After 5 weeks	..	25″	28″
Leaf length (After 5 weeks)		40·2	39·8
Leaf breadth (After 5 weeks)		0·05	0·84
Number of leaves after 5 weeks		7·0	7·6

After sprouting, the absence of sett-roots forces the shoot to develop its own shoot roots, and thus it was actually noticed that shoot-root development is much earlier in the second of the treatments mentioned above.

Khanna and Venkataraman[3] stated that tillering generally commences only after the development of shoot roots. Presumably this is the reason for the larger number of tillers recorded by us in the second treatment (*vide* Table I). The same authors have emphasized that shoot roots are more vigorous than sett roots and also that there exists a positive correlation between shoot-root vigour and the vegetative vigour in the cane.

Our studies reported here open up the possibilities for inducing early development of shoot-roots and thus take advantage of all the possible favourable physiological consequences of the same. Lastly we wish to emphasize and point that neither the sett roots nor the shoot roots are analogous to the seminal roots of the graminaceous plants. The buds of sugarcane can thus be independent of the sett roots for their nutrition and development, in the early stages; but are directly dependent on the shoot roots. Further studies to utilise this phenomenon in agronomical practice are in progress.

S. V. PARTHASARATHY.
B. APPAJI RAO.

Sugarcane Research Station,
Anakapalle,
February 27, 1948.

1. Barber, C. A., *Agr. J. India*, 1920, **15**, 185. 2. Venkataraman, T. S., *et al.*, *Ibid.*, 1922, **17**, 38. 3. Venkataraman, *et al.*, *Mem. Dept. Agr. India*, 1929, **16**. 145.

PHARMACOLOGY OF PHOSPHANILIC ACID

IN continuation of the study of the antibacterial properties of phosphanilic acid by Kanitkar and Bhide[1] it has been now found that phosphanilic acid also inhibits the growth of *M. tuberculosis in vitro* at a concentration of 1 : 5000.[2] This has led us to the study of the pharmacology of this drug, and this preliminary note gives the results of absorption in blood and toxicity of

phosphanilic acid to laboratory animals after administration of its solution in the minimum quantity of sodium bicarbonate.

Absorption in Blood.—Phosphanilic acid (300 mgms.) was given orally to a guinea-pig (wt. 600 gms.). There were no signs of irritation of the stomach. Phosphanilic acid was estimated after six hours in the blood from the heart, by Bratton and Marshall's[3] method of estimation of sulphanilamide. The drug, however, was not present in the blood.

Similar experiments were carried out with mice (weight 20 gms.) (dose 20 mgms.). But the drug was found to be absent in the blood. In the urine and fæces, however, it was present in considerable amount.

4 gms. of the drug were orally administered to a dog, on empty stomach, through a stomach tube. There were no signs of irritation of the stomach or vomiting. Blood removed from the vein of the leg after one hour, two and five hours was found to contain 1·12, 0·56 and 0·42 mgms. per cent. of the drug respectively. After 24 hours there was a negligible quantity of the drug in the blood.

Toxicity to laboratory animals.—Ten mice were fed with the drug (15 mgms. at a time, three times a day) for ten days. All the animals survived with slight loss in weight and a little disturbance of fur and loss of appetite. When the drug was discontinued they recovered their normal condition very soon. The blood from the heart was examined, but phosphanilic acid could be found only in traces. Histological examination of the solid organs of the animals such as liver, spleen, kidneys, etc., showed no damage excepting some changes similar to autolytic changes in the liver cells. Phosphanilic acid was not found in the liver at all but only in urine and fæces.

The drug, therefore, deserves further trials in intestinal infections as it possesses good antibacterial activity and is poorly absorbed even if given in large doses.

We thank Dr. B. B. Dikshit, Dean of the B. J. Medical College, Poona, for his advice and the interest in the work.

Maharaja Pratapsinh Chemical Lab.,
Sir Parushurambhau College, Poona,
G. S. PENDSE.
B. V. BHIDE.

March 11, 1948.

1. Kanitkar and Bhide, *Curr. Sci.*, 1947. **16**, 223. 2. Unpublished observation. 3. Bratton and Marshall, *J. Biol. Chem.*, 1939, **128**, 537.

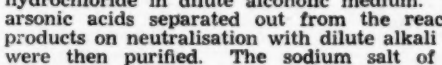
STUDIES IN ANTI-MALARIALS: BIGUANIDO-ARYL-ARSENICALS

IN spite of the various antimalarial drugs available for therapy, treatment of relapsing cases of malaria is considered a very difficult problem. It is known that the benign tertian and the quartan forms of the malarial parasites defy radical treatment and lead to persistent relapses. To free the system from these resistant forms, synergistic treatment with organo-arsenicals[1,2,3] has been advocated.

With a view to studying the pharmacological properties of organoarsenicals having certain essential structural features of the reputed antimalarial drug, paludrine,[4,5] several biguanido aryl-arsenicals of type (I) have been synthesised by reacting cyanoguanidine (for compound No. 1) and aryl cyano-guanidines (for compounds 2-6) with excess of para-arsanilic acid hydrochloride in dilute alcoholic medium. The arsonic acids separated out from the reaction products on neutralisation with dilute alkali and were then purified. The sodium salt of the acids were prepared and characterised. All the acids excepting No. 1 (Table I) and their sodium salts contain water of crystallisation and do not melt even at 300° C. Compounds Nos. 1 and 5 were crystallised from hot water; the others being insoluble in hot water and common organic solvents, were purified by precipitating with acids from alkaline solutions. They are soluble both in acid and alkali and are colourless.

TABLE I

N^3-R-(N^1) p-biguanido phenyl arsonic acids



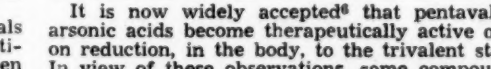
[Type(I)]

No.	R	Water of crystallisation in mols.	
		Arsonic acid	Sodium salt
1	H–	Nil	6
2	C_6H_5–	1	4
3	p-$CH_3C_6H_4$–	1	4
4	p-$OCH_3 \cdot C_6H_4$–	1	5
5	p-$Cl \cdot C_6H_4$–	2	5
6	p-$NH \cdot Ac.C_6H_4$–	..	5

It is now widely accepted[6] that pentavalent arsonic acids become therapeutically active only on reduction, in the body, to the trivalent state. In view of these observations, some compounds of the type (I) have been reduced with hypophosphorous acid and potassium iodide to the corresponding arseno-derivatives (type II),

TABLE II

p-p'-*Di* (*N^3-R-biguanido*) *arseno benzenes*



(Type II)

No.	R	Water of crystallisation in mols.		M-P. with decomp.
		Arseno compound	Dihydrochloride	
1	p-$CH_3C_6H_4$–	4	2	228°C.
2	p-$OCH_3C_6H_4$–	2	2	225° C.
3	p-Cl-C_6H_4–	2·5	2	230° C.
4	C_6H_5–	Unstable	..	..
5	H–	Not determined	..	..

which are fairly stable and practically insoluble in water. The yellow arseno-compounds possess no definite melting points, but their hydrochlorides melt with decomposition.

Full details will be published elsewhere.

Organic Chemistry Laboratories, Indian Institute of Science, Bangalore, *March* 15, 1948.

A. C. Roy.
B. H. Iyer.
P. C. Guha.

1. Goldman, *Amer. J. Med. Sci.*, 1938, **196**, 502. 2. Murphy, *South Med J.*, 1929, **22**, 363. 3. Bose, *Indian J. Pharmacy*, 1947, **2**, 14. 4 Curd and Rose, *J.C.S.*, 1946, 729. 5. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1946, **29A**, 1.

LIFE-HISTORY, BIONOMICS AND CONTROL OF JOWAR STEM-BORER (*CHILO ZONELLUS* SWINHOE)

Jowar (*Andropogon sorghum*) crop is usually attacked by stem-borers, such as *Chilozonellus*, *Sesamia inferens* and *Anthomyiad* flies, of which the first one is of considerable significance in the Bombay Province. The percentage of infestation at Poona varied from 57·7 to 79·4 in different varieties of *jowar* during 1945-46. Previous reports, however, indicate the maximum infestation going up to 86 per cent. in Surat during 1925-26.

The literature on this pest being very meagre, investigations were taken up with a view to studying the systematics of this species as well as its bionomics and other details.

An inquiry among entomologists showed that Rahman (Punjab) and Lal (U.P.) are of the opinion that *C. zonellus* is a synonym of *C. simplex*, whereas Hinton (London) and Cherian (Madras) differ from them in this respect.

Since considerable controversy existed about the presence of two species, namely, *C. zonellus* and *C. simplex*, detailed study was made in this respect, and all the characters were compared with the descriptions and diagrams collected from various countries like Japan, China and the British Museum, London. In India, species were collected from Poona, Padegaon and Delhi on different food plants, namely, *jowar*, maize sugarcane, rice, grasses, etc., and their characters noted.

Our investigations have shown that *C. simplex* and *C. zonellus* are two distinct species, and the species on *jowar* in India is exclusively *C. zonellus*. Its detailed life-history, seasonal history and the effect of different environmental factors on differentstages, have been thoroughly worked out. The nature and extent of damage has been studied and some control measures tried. Parasitization in nature was studied and the different species of parasites recorded.

There are 4 to 5 generations a year, and each life-history may occupy 29 to 210 days, depending upon temperature, overlapping of generations being not uncommon. The egg stage lasts for 4 to 9 days, caterpillar 18 to 193 days and the pupal 6 to 12 days. Hibernation during winter is in the caterpillar stage. Alternative host plants include many of the millets and other wild grasses. It is parasitized by *Dipterous* and *hymenopterous parasites*, the most important being a *tachnid* fly. Preventive methods of control, namely, destruction of "deadhearts" at the time of thinning, are of practical importance. Exposing the *jowar* stalks or stubbles to direct Sun's heat for 2 to 3 months, or burying the stubbles 5" below the earth for more than a month, kills all the hibernating caterpillars.

The detailed accounts of our findings are being published separately.

College of Agriculture, Poona 5, *April* 1, 1948.

K. N. Trehan.
D. K. Butani.

TRIALS WITH 666 AGAINST INSECTS AFFECTING GRAINS IN STORES

The toxicity of Gammexane to the rice weevil, *Calandra oryzæ* L., the red flour beetle, *Tribolium castaneum*, and the saw-toothed beetle, *Silvanus surinamensis*, was determined by (1) mixing the insecticide with the grains, (2) dusting the inside of bags, (3) dusting the godowns and outside of the bags.

One lb. of wheat grain mixed with Gammexane, D 230, and 100 specimens of each of the three species of insects were introduced separately into 2 lb. jars. The insecticide at five different levels of concentration was tried as shown in Table I. The experiment together with control was replicated three times. Temperature and humidity were recorded daily.

TABLE I

Effect of Mixing D. 230 with Wheat

No.	% D 230 mixed with talc	Percentage mortality of insect at 2-day intervals. (Average of three replications)												% 666 on grain
		2			4			6			8			
		Percentage Mortality												
		C	T	S	C	T	S	C	T	S	C	T	S	
1	0·1	70	20	64	83	28	74	90	38	74	100	58	86	0·0002
2	0·3	76	40	67	92	52	75	9·	64	77	100	84	87	0·0006
3	0·4	82	60	68	96	64	74	96	70	80	100	84	90	0·0008
4	0·45	86	64	72	96	65	75	97	73	82	100	93	94	0·0009
5	0·5	86	68	74	98	70	78	100	76	86	..	95	97	0·001
6	0·5% Talc.	36	12	4	46	32	21	52	40	27	60	48	34	Nil
7	Control	18	0	8	27	16	17	36	25	25	48	34	33	Nil

C = Calandra oryzæ. T = Tribolium castaneum
S = Silvanus surinamensis

The above table shows that 0·5 per cent. D 230 gave a 100 per cent. kill of *Calandra oryzæ* in 6 days. Other strengths also gave a 100 per cent. kill of the same insect, but in 8 days. *Tribolium castaneum* and *Silvanus surinamensis* were less affected by the insecticide, and cent. per cent. mortality of these insects was not obtained in the same period required to kill *Calandra oryzæ*.

Gunny bags of five lb. capacity were dusted on the inside with D 230, two lbs. of infested wheat was then introduced into each bag. The percentage mortality of *Calandra oryzæ* is shown in Table II.

Dusting of bags at 1 per cent. D 230 kills all the insects after about 7 weeks, and the effect of the treatment lasts even after 11 weeks.

Three godowns, each of 1,200 cft. capacity, containing 108, 105 and 210 bags of both rice and wheat were dusted with the insecticide at the different levels as shown in Table III. A fourth godown containing 100 bags was left untreated as control. The percentage mortality of *Calandra oryzæ* is given below.

TABLE II
Effect of dusting bags with D 230 on Insect Mortality

No.	% D 230 with talc.	Percentage mortality of *Calandra oryzæ*		
		20 days	51 days	81 days
1	0·25	14	50	35
2	0·5	46	75	100
3	1	50	100	100
4	Control	5	8	28

TABLE III
Percentage mortality of Calandra oryzæ *in treated godowns in a period of four days*

No.	% D 230 with talc	Room No.	Percentage mortality of rice weevil before dusting	Percentage mortality of *Calandra oryzæ*—days after dusting		
				2nd	3rd	4th
1	0·24	1	6·24	35·9	27·3	27·1
2	0·5	2	2·8	40	62·5	54·1
3	1	3	8·3	100	100	100
4	Control	4	3·1	7·2	6·1	8·4

The table shows that 1 per cent. D 230 gives cent. per cent. mortality on the second day.

All these data show that if all these treatments are applied simultaneously large quantities of grains can be saved from insect pests, especially from *Calandra oryzæ* which is the chief and serious pest of grains in stores.

Entomological Section,
Department of Agriculture,
Hyderabad (Dn.), M. QADIRUDDIN KHAN.
March 23, 1948.

INSECT PESTS OF STORED GRAINS IN BOMBAY GODOWNS

BEFORE war, Bombay didn't feel the necessity to import the grain from abroad, and whatever was imported from other provinces, was not stored for any considerable period, but it was disposed off immediately. Since 1944, however, the foodstuff was imported from outside and the introduction of rations resulted in stocking the food grains in godowns.

Before 1944, about thirteen species of store pests were recorded of which only five were of major importance. After 1944, however, the number of insects infesting stored grains went on increasing a list of which is given below.

TABLE I
Insect Pests in Stored Grains in Bombay

Scientific name	Food grains infested	Status	Remarks
Insects recorded up to 1944			
1 *Sitophilus oryza* L. (Small strain) ..	Wheat, Maize, *Jowar*, Bajri, Rice and Barley	Major	
2 *Rhizopertha dominica* O. ..	Wheat, *Jowar*, *Bajri* and Split pulses Barley	Major	
3 *Pachymeres chinensis* F. ..	Gram, Moong, Tur, Soya bean and *Urid*	Major	
4 *Pachymeres analis* F. ..	do.	Major	
5 *Sitotroga cerealella* O. ..	Wheat, *Jowar* and paddy	Major	
6 *Corcyra cephalonica* St. ..	Rice, *Bajri*, Wheat and Split pulses	Minor	
7 *Tribolium castaneum* H. ..	Damaged grains and milled products	Minor	
8 *Lætheticus oryzæ* Wat. ..	do.	Minor	
9 *Oryzæphilus surinamensis L.*	do.	Minor	
10 *Læmophlæus minutus* O. ..	Rice and Wheat	Minor	
11 *Alphitobius picous* O. ..	Wheat, Rice, *Jowar*, Bajri, *Barley* and Pulses	Minor	
12 *Tenebroides mauritanicus* L.	Wheat and Rice	Minor	
13 *Periplanata americana L.* ..	Wheat *Jowar* and Rice	Minor	
14 *Trogoderma granaria* E. ..	Wheat, *Bajri*, Barley, Rice, *Jowar* and Pulses	Major	Introduced from the Punjab, C.P. and Sind with Wheat and Rice
15 *Plodia interpunctella* H. ..	Canadian Wheat	Major	With American Wheat, in 1945
16 *Ephestia cautella* Wlk. ..	Australian and Canadian Wheat	Major	With Australian Wheat, in 1945
17 *Sitophilus granarius* L. ..	Wheat, *Jowar* Bailey and Maize	Major	With American Wheat, in 1944
18 *Sitophilus oryza* L. (bigger strain) ..	Wheat, Maize, *Jowar* and Barley	Major	With American Wheat in 1946
19 *Tribolium confusum* J.Du.	Damaged grains and milled Products	Minor	With American Wheat
20 *Bruchus phaseolus* L. ..	Gram	Minor	On Gram from other provinces
21 *Pyroderces rileyi* W. ..	Maize	Minor	On Maize from Argentina in 1946

College of Agriculture, K. N. TREHAN.
Poona 5, S. V. PINGLE.
March 3, 1948.

REVIEWS

Modern Gas Turbines. By Arthur W. Judge. (Messrs. Chapman & Hall Ltd., London), 1947. Pp. xii + 311. Price 28*sh.*

The gas turbine has already proved itself to be a serious rival to the reciprocating engine in some important fields of use. Granted the requisite knowledge and facilities, it is cheaper to make than corresponding reciprocating engines; moreover, moderate metallurgical advances in certain directions will greatly increase the extent to which the gas turbine can outrival reciprocating engines. Thus, it may be good policy for India not to contemplate eventual manufacture of certain larger and more difficult types of reciprocating internal combustion engines but, instead, to go direct to gas turbines. It is thus patent that the subject of the book under review has a special interest for India.

To those who require to assess the possibilities and limitations of gas turbines for various fields of application, Mr. Judge's clear exposition will be of considerable help at the present stage. The author gives a brief history of the development of gas turbines and follows this with some general considerations. He then outlines the fundamentals of gas turbine thermodynamics and discusses gas turbine efficiencies and how to improve them. There follows a chapter on closed-cycle gas turbines and another on exhaust-gas turbines for supercharged engines. The next chapter deals with gas turbines for aircraft. This relates mainly to jet-engines as more experience has been gained with these engines than with those which deliver power through shafting. The concluding two chapters concern typical applications and performances of gas turbines, and materials for gas turbines. There are two short appendices which comprise notes on turbine-blade design and a description of some blade-fixing methods.

A considerable bibliography is given for the guidance of those who need to study particular aspects of the subject more fully. Important further contributions continue to appear in technical literature but the references given extend into 1946.

The book is not a design manual: it is largely descriptive, but fundamental principles and facts are stated, thus forming an excellent introduction to the subject.

Little is given concerning dynamical aspects of gas-turbine design, such as balance-whirling, vibration of turbine discs and blades, centrifugal and temperature stresses, high-speed bearings, and so forth. To a large extent these are covered by manuals on steam turbine design, but the gas turbine has its own special dynamical and stress problems. Again, heat interchangers for gas turbines are only referred to diagrammatically. However, it is to be realised that there is limitation to information released.

The book is clearly printed and is well illustrated with numerous graphs, drawings and photographs.

B. C. CARTER.

Electrons (+ and −), Protons, Photons, Neutrons, Mesotrons and Cosmic Rays. By R. A. Millikan. (The University of Chicago Press, Chicago. Agent: Cambridge University Press), Revised Edition, 1947. Pp. 642. 124 Illustrations. Price 30*sh.*

In 1917 the Chicago University Press published a small volume entitled *The Electron*, written by Prof. Millikan. Seven years later, a revised edition of the same book appeared. A book with the present title was first published in 1935. This itself was an expanded edition of the *The Electron*. The volume under review is the outcome of a revision and expansion of the 1935 edition, necessitated by the extra-ordinary advances made during the last twelve years, in our knowledge of these fundamental particles. The appearance of this book will be welcomed by many students of physics for whom the earlier edition has become a standard text. The first four hundred pages of the earlier edition have been reproduced in the present volume. Only minor changes, mostly in the values of units, have been made. Five new chapters (XVI-XX) covering well over 200 pages and containing entirely new material and a full discussion of the results of recent studies, especially in the field of cosmic rays and nuclear energy, have been added. It is a remarkable testimony to the author's presentation that new chapters could be added to the existing text, maintaining at the same time the continuity in the development of the subject. In order not to break the thread of the discussion in the body of the book, the author has collected the mathematical proofs and put them in Appendices at the end of the book, which are no less than ten in number.

The first eight chapters contain, among others, a detailed account of the experiments which led to an accurate determination of the electronic charge. The structure of the atom and the nature of radiant energy form the subject-matter for Chapters IX and X respectively. The next chapter on waves and particles gives a brief and clear account of the particle wave dualism in modern physics. The succeeding chapter deals with spinning electron with particular reference to the spectra of stripped atoms and the new spectroscopic rules. The discovery of the cosmic rays and the early experiments carried out to elucidate their nature and origin are described in detail in Chapter XIII. The next two chapters deal with fascinating topics such as the positron, neutron, and artificial transmutation. Only brief summaries of the experimental facts are given.

Chapter XVI, the first one of the new chapters, deals briefly with the release and utilisation of nuclear energy. Tracing the history of the discovery of nuclear fission and the possibility of large-scale release of nuclear energy, the author makes a strong plea for conserving rather than burning up a rare and precious element, namely, uranium, whose abundance is only a very small

fraction. According to him it is too valuable a material for scientific purposes to be wasted for major power projects so fully provided for by the inexhaustible supplies of solar energy. The succeeding three chapters with respective headings, "Geomagntic Studies on Cosmic Rays at Low Altitudes", "The Discovery and the Significance of the Mesotron", and "The Nature and Number of Incoming Primary Rays", deal mainly with the different aspects of cosmic ray studies carried out since 1932. Results of airplane surveys of latitude effect and east-west effect, and of sounding balloon flights that carried the electroscopes practically to the top of the atmosphere, have been described in some detail and discussed. The atom annihilation hypothesis put forward by Millikan as to the origin of cosmic rays and the evidence in support of the same have been dealt with in the last chapter. Careful studies of the latitude distribution of incoming cosmic rays carried out by Prof. Millikan and his associates in India, South America, Canada, Mexico and the United States, have been referred to in great detail in this chapter. The conclusions derived from these studies have been shown to support the predictions of the atom annihilation hypothesis.

On going through the book, especially the chapters dealing with cosmic rays, a careful reader is bound to notice an indulgence on the part of the author in presenting a detailed analysis of particular investigations with which he has been intimately associated. No doubt, these investigations are extremely interesting and important. But, the usefulness of the book would have been very much enhanced if a more balanced and critical summary of all the contemporary investigations in the field of cosmic rays had been presented. In spite of this limitation, the present volume contains an extremely useful resumé of a wide range of investigations in atomic physics. It is profusely illustrated with many charts and Wilson cloud Chamber photographs. It is written in a simple and clear, though assertive style. The book is an important addition to the literature of modern physics and should prove to be a welcome companion not only to those working on cosmic rays but also to every student of physics.

R. S. K.

An Introduction to the Theory of Seismology. By K. E. Bullen. (Cambridge University Press), 1947. Pp. 276. Price 18*sh.* net.

The author of the book is well-known in the field of seismology; his contribution in the form of the improved 'Travel-time Tables for seismic waves' remains an outstanding achievement. And now he brings out a new book, *An Introduction to the Theory of Seismology*, which includes in a nutshell a world of information Coming from the Jeffreys school, the author naturally puts in the forefront the views and thoughts of that eminent school: he has not, however, neglected to mention, side by side, the accepted views, if any, of the American, Japanese or German seismologists. He has taken great pains in making the complex subject of seismology as interesting as possible, by gradually approaching the actual condition from the ideal, and by weeding out the non-essentials with utmost care.

In the earlier chapters of the book the author develops the mathematical theories of elasticity and of waves and vibrations. He shows how in the investigation of earthquake phenomena both the vibration theory based on normal mode considerations and the wave theory can be applied. The concept of rays is then introduced in dealing with the propagation of waves in three dimensions, and, on this consideration, characteristics of the waves are clearly brought out. Chapters dealing with seismic waves have been thorough and most useful. His method of presentation is clear and convincing. For example, in determining the cause of the oscillatory movements that are observed at the surface he introduces at first several factors which may contribute, but, after discussing one by one in detail, shows that the essential cause of the observed oscillatory movements must be sought in the heterogeneity of the Earth. Similarly, it has been shown how the possible effects of departures from isotropy due to initial stress become insignificant even when second-order terms are taken into account; logical conclusion that follows is that in seismology the first-order theory will lead to very accurate results in most problems. Bodily waves and surface waves have been considered in great detail and special attention devoted to Rayleigh and Love waves. Since seismic waves penetrate all parts of the Earth's interior and emerge at the outer surface, bringing evidence of the regions they have traversed, study of these waves would naturally lead to useful information. The book includes many advances that have been made in this direction. Indications have been given as to how the elastic parameters of the Earth's crustal layer as well as of the interior can be investigated, and several discontinuities and transition layers so far discovered within the Earth are included in tabular form. A good portion of the book is devoted to discussion on earthquakes, their causes, intensities, epicentral distance and focal depth; it includes the useful table of Gutenberg and Richter showing the distribution of deep-focus earthquakes.

One feels that the chapter on the principle of the seismograph has been rather brief. This part could probably be expanded with fully developed equations using terms of the second order for the benefit of those engaged in the design, and construction of instruments. If the principal features of all the modern types of seismograph were included together with their illustrations, perhaps the value of the book would have been further enhanced. A page on bibliography could also be usefully added at the end.

The author is to be congratulated in having succeeded in his attempt to present so elegantly the essentials of the theory of seismology in so few pages. The book will undoubtedly be endeared by all interested in seismology.

J. M. Sil.

Dissociation Energies and Spectra of Diatomic Molecules. By A. G. Gaydon. (Chapman & Hall, Ltd., London), 1947. Pp. xi + 239. Price 25*sh.* net.

While giving an appreciation of another book, *The Identification of Molecular Spectra* (*Curr. Sci.*, 1941, 12, 541), of which Dr. Gaydon was part author, we expressed a wish that

other data should have been included. The present book supplies part of the need thus felt: It brings together a critically assessed mass of information regarding the dissociation energies of some 263 diatomic molecules, the value being uniformly based on up-to-date values of the fundamental physical constants, e, h, c etc. As an introduction to this collection a description is given of the various methods by which dissociation energies are evaluated, *viz.*, convergence limits, Birge-Sponer extrapolation, predissociation, electron impacts and thermochemical methods. The application of these methods is also illustrated in detail in the case of certain molecules like N_2, N_2^+, NO, CO, CO^+, CN, F_2, HF, C_2, OH, S_2, SO, Se_2 etc., where the author has suggested values which are free from some of the errors associated with older values. In discussing the data leading to the new values, Dr. Gaydon shows himself an impartial and discriminating critic. The first three chapters give a resumé of the theory of diatomic molecular spectra sufficient to follow the notation and the discussion in the later chapters. Reproductions of spectra are also given so as to illustrate some of the points discussed. The book not only serves a very useful purpose in itself but also provides an admirable model to be followed when a research worker wants to survey the existing literature and make up a list of data and results relating to any subject in which he is interested. Excepting that the price seems high according to pre-war standards, the book will certainly commend itself to all workers in the field of molecular spectra.

T. S. S.

Fundamentals of Photography. By Paul E. Boucher. (D. Van Nostrand Co., Inc., New York), 1947. Pp. 395. Price 22*sh.* 6*d.*

Although books on Photography are legion to-day, and attract unfailing attention on the stalls of any bookseller of standing, it is well known among senior workers in the field that the percentage of really dependable and worthwhile publications is very small. For the scientific worker or the serious student of photography, there have been on the market only two or three treatises on the subject which have proved authoritative, and reasonably comprehensive; Paul Boucher's *Fundamentals of Photography* is one of these books. It is undoubtedly a pleasure to notice that Messrs. Van Nostrand Co. have brought out recently a revised second edition of this already reputed text-book.

"A course in photographic technique should be pursued with the same systematic concentration both in theory and practice as any other scientific subject," stated Mr. Lockington Vial, one of Britain's leading scientists, who has made distinctive contributions to the progress of photographic science. The principle enunciated above has been fully kept in view in the preparation of the book under review. Every chapter has been written with such great care and clarity, that no statement is dubious or incorrect, while at the same time brevity and compactness have been attained by the elimination of unnecessary repetition and circumlocution. The entire ground of technical and scientific photography, including colour photography, X-ray photography and motion picture photography, is covered without omitting any relevant topics. A unique feature of the book is the series of laboratory experiments described at the end of the volume. These cover nearly 100 pages, and have been so systematically planned that any student who goes through the 25 experiments in a good photographic laboratory should gain a perfect mastery over the practical aspects of photographic technique, and the scientific basis of all photographic processes. The appendices and the glossary at the close of the book are indeed very useful and informative. The book is undoubtedly a boon to students and scientific workers who may be looking out for a really compact and up-do-date text-book on the subject, but that does not lessen the value of the book as a guide and reference manual for all amateur and professional photographers in general.

I cannot, however, fail to make one observation. It is usual in text-books on photography to devote the first chapter to the historical development of photography, since it makes not only interesting reading but also provides a definitely better understanding of the latest developments and modern methods. One well-known author of a text-book on photography has allowed 60 pages out of a total of 600 pages, to the history of photography, and there may be some difference of opinion as to whether such a detailed treatment is called for. Paul Boucher has, however, erred on the other extreme by dismissing the subject in less than two pages of his book. This is scant courtesy to a topic that covers a century of progressive developments, and it results in the omission of such great names as Fox Talbot, who made outstanding contributions to the development of photography in the first half of the 19th century. The book would increase considerably in usefulness if the historical outline is extended a little more.

Notwithstanding this criticism the book is an extremely valuable treatise that can be heartily recommended to every serious student of photography.

S. Lakshminarasu.

Frequency Modulation Engineering. By Christopher E. Tibbs. Foreword by Leslie H. Bedford. (Chapman and Hall, Ltd., London), 1947. Pp. 310. Price 28/-.

The present volume is a well systematised treatment of the subject of frequency-modulation engineering and makes the study of the subject as a whole easy by including wide range of topics covering every aspect of the subject within its pages. The author deals, in eleven chapters, with all the important aspects of the subject—fundamentals of frequency modulation, propagation of f.m. signals, aerials, f.m. transmitters and receivers, measurements on frequency modulation equipment and practical uses of f.m. signals. Chapter two presents the basic ideas relating to the frequency and noise structure and their suppression in a frequency modulation system, which are most appropriate and presented with great clarity. Chapter five

mainly dicusses the points concerning the propagation of ultra-high frequency signals with some reference to those of frequency modulated type. Chapter six has been devoted in its latter pages to the consideration of ultra-high frequency aerials specially for the frequency modulation system. Chapters seven, eight and nine, relating to transmitting and receiving equipment in frequency modulation systems, have been presented very well with sufficient theoretical considerations, circuit diagrams and details of commercial circuits. Chapter ten has increased the usefulness of the subject by including topics like method of measurement of frequency deviation, frequency modulation signal generator, measurement on frequency modulation receiver. Chapter eleven discusses briefly the use of f.m. systems for broadcasting, radio telephony, picture transmission, television, etc., and concludes by a reference to the recently developed pulse-time modulation system.

The author's approach to the various topics is that of a practical engineer. The work abounds in diagrams, figures, tables and information of a practical nature. The paper, printing and general get-up leave nothing to be desired. The reviewer recommends this excellent treatise on the subject to advanced students of electrical communication engineering as well as radio engineers concerned with broadcasting and communication projects.

S. P. CHAKRAVARTI.

Kemp's Handbook of Rocks—completely revised and edited by Frank F. Grout. (D. Van Nostrand Company, Inc., New York; sixth edition, third printing, 1946.) Pp. 300 + i-vii. Price 20*sh*.

This is a good text-book of Petrology although the author has set for himself the difficult objective of offering a fairly comprehensive knowledge of rocks without invoking the aid of the special techniques of the petrographic microscope. In the original form in which the book was written just about half a century ago, by the late Professor Kemp of Columbia University, it had been acknowledged as one of the most widely used text-books of the time for over a generation. However, text-books go out of date, sooner or later, and they have to 'grow' with time. Kemp's *Handbook of Rocks* has now reached in the sixth edition. The revisor and editor, Prof. Frank F. Grout, himself the author of the well-known book, *Petrography and Petrology*, has greatly enhanced the usefulness of the book under review, while retaining the charming style and method of treatment of the original author.

The fourteen chapters of the book cover all the important aspects in the study of rocks—their description, methods of classification and modes of origin. The determinative tables given in respect of the common rock-forming minerals and the igneous rocks, as also the several tabular statements listing the simple criteria for distinguishing between orthoclase and plagioclase felspars, pyroxenes and amphiboles, phenocrysts and amygdales, phenocrysts and metacrysts, etc., are likewise very useful. The field and laboratory methods are dealt with in such a manner as to offer a direct and helpful guidance to the student. The latest developments in the study of sedimentation, and the well-logging specialities have also been explained. Economic aspects of the various rocks have been pointed out.

In short, the book presents the study of rocks in a very clear and simple manner so that the average undergraduate student or any one interested in the subject, provided of course he has some previous knowledge of the fundamentals of geology, could easily follow and understand. Even the complicated and ticklish questions on the mode of classification and origin of the rocks are alluded to in terse statements. For instance, speaking of the metamorphic rocks it is said, "These excessively altered rocks are grouped into a separate, so-called 'metamorphic' division which is a sort of 'omnibus' of unsolved geological problems" (p. 23). "When dealing with metamorphic districts, the student must expect to find contradictory evidences, for a long series of events may have left in the rock a series of minerals and structures formed under a variety of conditions" (p. 250). "It is chiefly because the original cannot always be recognised that the metamorphic class of rocks was separated" (p. 253). "The dividing line between schist and gneiss is arbitrary and expert students may disagree" (p. 249). Again, look at the fine encouraging words to the students regarding the practical difficulty in distinguishing rock-types: "These errors must be expected by field workers at places, and the corrections made by laboratory study afterward are no reflection on the character of the field work" (p. 51). The text has numerous elegant expressions like these.

The book is finely printed, amply illustrated and well bound. The reviewer thoroughly appreciated reading the book with profit to himself.

M. B. R. RAO.

A Manual of Vacuum Practice. By L. H. Martin and R. D. Hill. (Melbourne University Press, Melbourne), 1946. Pp. 120.

Fundamental knowledge, in vacuum technique is as important as glass-blowing to any post-graduate student who has to start research either in physics or in chemistry. The book under review gives a nice introduction to the subject both in theory and in practice. Even to an experienced worker in vacuum technique, the book provides an interesting and illuminating reading. Theoretical portions like, molecular flow, impedance, flow through tubes, speeds of pumps and other measurements have been given in the first chapter. The usefulness of this chapter is further enhanced by the typical calculations in the design of vacuum systems at the end of the chapter. Subsequent chapters are devoted for a critical study of the measurement of pressure, description of vacuum pumps and vacuum plumbing.

The information given in the appendices is as important as the main contents of the book. Often a beginner in vacuum work will have to waste a lot of time in locating the defects of the system when the desired vacuum is not obtained. The choice of grease for the joints, the correct dehydrating agent in the circuit, the uncontaminated oil for the vacuum pump, the employment of purified mercury in the various measuring instruments, constitute but a few of

the many precautions to be taken in vacuum work. The first ten appendices give the details of manipulation in vacuum work while the next eight give useful data often required by the vacuum worker. The appendix dealing with the purification of mercury, however, is far from satisfactory. The author has omitted the cleaning of mercury with water after the nitric acid treatment. For the air distillation of mercury, a spiral of air-cooled condenser is preferable to the water-cooled condenser shown in Fig. 53. It is obvious that purification by vacuum distillation is essential when mercury has to be employed in instruments used in vacuum technique. It is surprising to find that this process has been completely omitted in the book.

M. R. A.

The Tuberculosis Association of India—Eighth Annual Report, 1946. By Lt.-General R. Hay and B. M. Cariappa. (Tuberculosis Association of India, New Delhi.) Pp. vii + 22 + 96.

Six months after the inauguration of the Tuberculosis Association of India World War II broke out, hampering much of the activities of the Association. The Association, however, has been able to build up during these critical years a network of non-official organisations in different parts of India and has moved public opinion in favour of accepted methods in the campaign against tuberculosis. There are today thirty-four Provincial and State Associations affiliated to the Central Organisation.

The Report gives an account of the various activities of the Association. The Association has built up two model institutions—The Lady Linlithgow Sanitorium and New Delhi Tuberculosis Clinic—both of which have been serving as training institutions in anti-tuberculosis work for medical personnel, health visitors and nurses. A scheme for organised home treatment has been increasingly popular at the above institutions. At the instance of the Association, tuberculosis diploma courses have been instituted at several University Medical Colleges, *viz.*, Mysore, Delhi, Calcutta and Madras.

It is gratifying to note that private individuals have evinced keen interest in publishing anti-tuberculosis literature. A pamphlet prepared by Mrs. Helen Thomas in a South Indian vernacular is a case in point, which the local Association may well utilise. Another notable feature is the appointment of corresponding members from other countries, a list of which is given on pp. 56-59. In this way, the authors hope to secure the benefit of contact with the best work and workers to be found abroad. There is also a proposal to publish an *Indian Journal of Tuberculosis* as a permanent feature of the activities of the Association.

The error on p. 7, line 6, "D.T.D. course", is to be read as "T.D.D. course". The Appendix gives an account of the various activities of the local associations together with some addresses at the Seventh Annual Meeting of the Association.

A. S. RAMASWAMY.

Festschrift zum 60*e* Geburtstage von Professor Dr. Embrik Strand (1936-1939). (Commemorative volume celebrating the 60th anniversary of the zoologist, Professor Dr. Embrik Strand.) Vols. I-V, pp. 3,438, 104 plates and 687 text-figs. Riga (Latvia, U.S.S.R.).

Those volumes, published in honour of the well-known scientist of Riga, Prof. Strand, the Director of the Systematic Zoological Institute and the Hydrobiological Institute of the Lettish University of Riga, contain 194 papers by 126 zoologists and palæontologists from 25 different countries of Europe, the Americas, Asia, Africa and Australia. Each volume is complete by itself, and may be purchased singly. The volumes may also be obtained by exchange from Professor Strand. The fifth volume (pp. 615-749), contains a complete index of all the Latin names of animals in the five volumes. Out of the 194 papers, 12 treat of general zoology, 3 of biographies of zoologists, 3 of natural philosophy, 3 of various invertebrata, 1 of protozoa, 12 of vermes, 3 of tunicata, 4 of echinodermata, 9 of mollusca, 1 of different arthropoda, 4 of crustacea, 42 of arachnida, 1 of myriopoda, 85 of insecta, 1 of various vertebrata, 1 of pisces, 3 of reptilia, 12 of aves, 5 of mammalia, and 10 of palæontology. Consequently, specialists in all groups will find something to interest them in these volumes. The contributors are usually well known scientists. Most of the papers are systematic, faunistic and zoo-geographical, but there are also some dealing with development, physiology, biology, etc.

These commemorative volumes differ from the general run of such writings in a variety of ways. Firstly, the quantity of matter they contain is enormous, and this, in its turn, is related with the fact that an unusually large number of contributors, from practically all over the world, have collaborated in the production of these volumes. It is striking that all the contributors are foreigners and apparently not under any debt or personal obligation to Professor Strand, which shows to what an extent Prof. Strand is held in esteem by his colleagues all over the world. The volumes are sumptuously produced, lavishly illustrated, and cover a very wide range of zoological subjects. We consider that no zoological library would be complete without them. They combine in them a well-deserved tribute to the energy and devotion of Professor Strand to the cause of Zoology, as well as a practical contribution to original zoological research.

M. L. ROONWAL.

SCIENCE NOTES AND NEWS

World Scientific Conference

The International Scientific Conference, devoted to the discovery by the Indian Physicist, Sir C. V. Raman, of a new method of analysing the chemical composition of substances by light rays, was opened at Bordeaux on April 5th. Sir C. V. Raman was present at the Conference which was also attended by Prof. Max Born, of Edinburgh University.

Indian Central Cotton Committee

The Government of India are sending a delegation consisting of Dr. V. G. Panse, and Messrs. R. G. Saraiya, C. S. Patel, and N. G. Abhyankar to the Seventh Meeting of the International Cotton Advisory Committee to be held at Cairo from April 1st to 8th.

The International Cotton Advisory Committee is expected to review the world cotton situation with special reference to production, utilisation and trade and to discuss the question of the progress and efficiency in production, expanding the use of cotton products, etc.

Dr. Gilbert Fowler

Dr. Gilbert Fowler of Bangalore, S. India, has been elected an Honorary Fellow of the Institution of Sanitary Engineers in recognition of his services to sanitary science, particularly in connection with the activated sludge process of sewage purification.

He has also been elected an Honorary Member of the Engineers' Club of Manchester, England, of which he is a foundation member.

Watumull Dental Fellowship

The Selection Board of the All-India Dental Association for the Watumull Dental Fellowship for the year 1948 have selected Dr. Baij Nath Mehra of the Calcutta Dental College. He will now proceed for two years' training in the United States of America.

Dr. M. R. Jayakar

Dr. M. R. Jayakar has been appointed the first Vice-Chancellor of the Poona University for a period of two years.

The Entomological Society of India

The following have been elected as the Office-bearers of the Society and the *Indian Journal of Entomology* for the year 1948 :—

President : Dr. H. S. Pruthi.

Editors for 1948-50 : Dr. K. B. Lal, Dr. H. S. Pruthi, Mr. R. B. Ramachandra Rao, Mr. B. C. Basu, Dr. K. N. Trehan, Dr. N. C. Chatterjee, Dr. E. S. Narayanan, Mr. M. C. Cherian, Dr. I. M. Puri.

Prevention of Malaria

The Harvard scientists reported that they have opened the road to prevention of malaria by discovering a certain blood component which is vital to the growth and reproduction of the disease-causing parasite.

Doctors Ralph McKee and Q. Geiman of Harvard Medical School, suggested that the neutralisation of the component might eventually eliminate the tropical disease by depriving the malaria parasite of nourishment and halting its reproductive cycle. They identified the subject of their research as methionine, one of the amino acid components of protein which is present in blood plasma.

A study of metabolism and feeding habits of the malaria parasite showed that the disease-producing organism feeds on methionine and other compounds, found in plasma as well as on red blood cells which plasma surrounds. They said they started to investigate other compounds in their search for the method of neutralising such blood components in a way which would prevent the malaria parasite from drawing sustenance from them.

Atomic Energy in India

The Prime Minister of the Indian Union introduced the Atomic Energy Bill in the Dominion Parliament on March 23rd.

Under the Bill, Government will acquire powers to control the development of Atomic energy in India and the disposal of the relevant raw materials so that these may be used for the advantage of the people as a whole.

The provisions of the Bill are drafted on the lines of the Atomic Energy Act, 1946, as obtaining in the United Kingdom.

Blister Blight in Ceylon

Blister Blight, tea disease, which appeared on an estate in the Dolosbage area of Ceylon late in October 1946, has now spread to most of the tea districts in the Island. Climatic conditions in the Island are said to be much more favourable to its spread than in North-East India where it is reported to be existing ever since 1858. The disease has reduced, according to the latest estimate, the total production of tea in the Island by ten per cent., but the Government which is wide awake to the situation, has under contemplation several measures to check the further spread of it.

Blister Blight caused by *Fungus Exobasidium Vexans*, Massee, is mostly spread during the period of pruning when young buds and shoots are most susceptible to infection. The incubation period of the disease is said to be about three weeks.

Dr. Roland V. Norris, Director of the Tea Research Institute in Ceylon, in his annual report for 1946, published recently, says, "Bushes in North-East India are out of plucking during the winter months and are pruned during that period. In consequence, recovery from pruning during which the young buds and shoots are most susceptible to infection takes place at a time when conditions are most unfavourable to the survival of the fungus spores responsible for spreading the disease. These spores are produced in enormous numbers and it is fortunate indeed that in contrast with many other varieties of spores, they are relatively susceptible to, and their visibility greatly reduced by high temperatures and dry conditions. It may safely be assumed that it is largely due to this factor that the disease, in the ninety years during which it has been recognised, did not spread at an earlier date to South India or Ceylon.

River Projects

Planning for multi-purpose river projects in India entered upon a new phase with the Government's establishment of a Central Designs Organisation under the Central Water-Power Irrigation under Navigation Commission.

"CWINC", as this Commission is called for short, is at present engaged in preliminary investigations of the Kosi, Mahanadi, Narbada, Tapti, Indravati and Assam Valley projects, while its investigations in respect of the Hirakud Dam Project, on the Mahanadi, have reached a stage when construction work has been authorised.

The Central Designs Organisation, which will have seven sections dealing with dam, canal, mechanical and hydroelectric engineering, technical studies, drawing and research for dams and appurtenant works, is expected to take up immediately the designing of the Hirakud Dam, the power plant proposed there and the canals and other features of the scheme. At the same time, it will prepare preliminary, and whenever necessary detailed, designs for the Kosi, Narbada, Tapti, and other projects.

It is proposed to send abroad, during the next five years, selected engineers for specialised training. These trainees to be sent out at the rate of six a year, will receive training abroad for about two years, the main centres being the U.S.A., the U.K., Canada, Sweden, Switzerland and the U.S.S.R.

The Government of India have also decided to sponsor an "International Commission on Irrigation and Canals" with its central office in this country. The Commission's objects will be to encourage progress in the design, construction, maintenance and operation of irrigation works and navigation canals by the interchange of information among its various national committees, by holding conferences, by organising studies and experiments and by the publication of reports, documents, etc. The Central Board of Irrigation will be the Commission's National Committee for India.

Preservation of Fruit and Vegetables

Practical advice to wholesale firms, and some retail shops in the fruit and vegetable trade are given in a "Food Investigation Leaflet No. 9—Entrepot Cool Storage of Fruit and Vegetables", published by H.M. Stationery Office (Price 2d., by post 3d.). The leaflet deals with short-term refrigerated storage over a period ranging from four to ten days.

Recommendations are given for the specifications of cool stores in which temperatures ranging from 32° F. to 45° F. and a relative humidity of around 85 per cent. are maintained, with automatic control of temperature.

Details of storage temperatures for different fruits and vegetables are given, together with hints as to special treatment required for certain products. For ease of operation of the cool stores, the fruits and vegetables are divided into two classes, those to be stored at 32° F. to 34° F. and those to be stored at 40° F. to 45° F. Notes are given on tainting of one variety of fruit or vegetable by another in the store.

Further information can be obtained from the Officer in Charge (Dr. J. C. Fidler), Covent Garden Laboratory, D.S.I.R., 9-13, Kean Street, London, W.C. 2.

A Goniometer cum Microscope

The Andhra Scientific Instruments Co., Masulipatam, has designed a new theodolite goniometer of a universal type of crystals at all possible orientations. An outline of the general features and the use of the instrument is given in an article appearing in the December issue of the *Journal of Scientific and Industrial Research (India)*. The main features of the instrument are (1) two circular scales, one in the horizontal and the other in vertical plane; (2) the crystal-holder, (3) the Collimator with illuminating arrangement, and (4) the telescope with a combination objective enabling its use as a low power microscope as well. The system is mounted on a rigid cast iron base provided with levelling screws for the adjustment of the scales exactly horizontal and the other vertical. The instrument is a self-contained unit provided with a low tension transformer feeding the illuminating system direct on the 220 volt A.C. mains. The instrument will be a valuable aid to X-ray specialists and crystallographers.

National Institute of Sciences

Pandit Jawaharlal Nehru, the Prime Minister of the Indian Union, laid the Foundation Stone of the National Institute of Sciences of India on the 19th of April at New Delhi. Sir S. S. Bhatnagar, the President of the Institute, welcomed the Prime Minister on the occasion, and Pandit Nehru delivered an address before performing the ceremony.

Training Colleges in Britain

The British Ministry of Education proposes to set up a chain of national training colleges for technologists, scientists and industrial research workers. The plan will be worked out by an important new Advisory Council on Education for Industry and Commerce, consisting of representatives of educational bodies, local authorities, employers and trade unions.

The Council will keep in close touch with the leaders of industry, science and universities and will have the task of co-ordinating the activities of the training establishments to ensure that full use is made of the nation's brains and technical skill. In addition, the Council will study the question of examinations and scholarships and will be entrusted with the task of seeing how training facilities and equipment can be improved to the fullest possible extent.

ERRATUM

Volume 17. No. 3, March 1948, page 101, line 5: *Read* "variety did not seem to develop" *for* "variety did seem to develop", etc.

330 48 Printed at The Bangalore Press, Bangalore City, by G. Srinivasa Rao, Superintendent and Published by Dr. M. A. Govinda Rau, M.A., Ph.D., for The Current Science Association, Bangalore

COMMONWEALTH AGRICULTURAL BUREAUX

This organization, formed by the Government of India in collaboration with those of the British Commonwealth and Empire, provides up-to-date information in the form of abstracting and reviewing journals, technical communications and bibliographies on all aspects of science and practice as applied to agriculture, horticulture and forestry.

Journals.—The following list comprises journals and other periodical publications. Subscription rates are quoted after each; in certain cases (journal marked with an asterisk) a 20 per cent deduction is made for subscribers in the British Commonwealth who send their subscriptions direct and not through a bookseller.

	Ann. Sub.		Ann. Sub.
Bulletin of Entomological Research	(40*s.*)	*Plant Breeding Abstracts	(35*s.*)
Review of Applied Entomology (Series A)	(40*s.*)	*Field Crop Abstracts	(35*s.*)
Review of Applied Entomology (Series B)	(20*s.*)	*Herbage Abstracts	(35*s.*)
Review of Applied Mycology	(40*s.*)	*Horticultural Abstracts	(35*s.*)
*Soils and Fertilisers	(35*s.*)	*Animal Breeding Abstracts	(35*s.*)
Veterinary Bulletin	(40*s.*)	Helminthological Abstracts	(35*s.*)
Index Veterinarius	(100*s.*)	*Dairy Science Abstracts	(35*s.*)
Nutrition Abstracts and Reviews	(60*s.*)	*Forestry Abstracts	(25*s.*)
		Forest Products and Utilization	(10*s.*)

Owing to increasing costs of production, the subscription rates for most of the journals of the Commonwealth Agricultural Bureaux have been increased. The new rates for **Forestry Abstracts** and **Forest Products and Utilization** which will come into force in May 1948 have not yet been decided.

Technical Communications

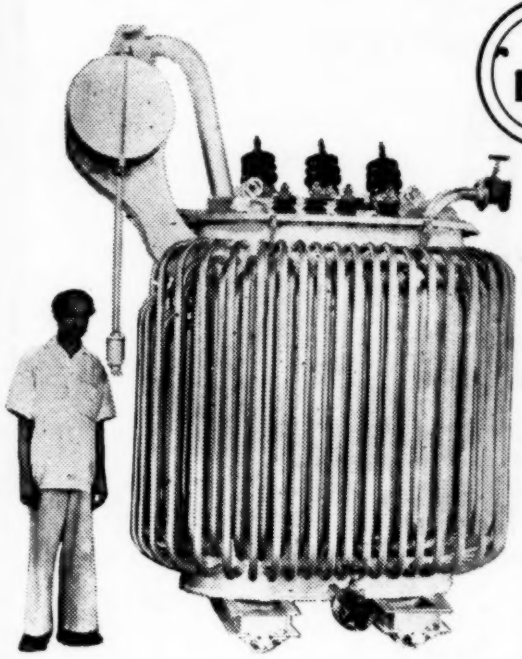
	Price
The effect of rainfall on plant disease distribution in the Anglo-Egyptian Sudan.	3*s.*
Species of Alternaria on Brassicae.	3*s.*
The Cause of Variation in the Incidence of Blackarm Disease of Cotton in the Sudan Gezira	2*s.* 3*d.*
The Causes of Variation in the Incidence of Cotton Leaf Curl in the Sudan Gezira.	2*s.* 3*d.*
Phenothiazine 1942-46: A Review and Bibliography.	4*s.*
The Vitamin Requirements of Swine.	1*s.*
The Correlation of the Amino-Acid Composition of Proteins with their Nutritive Value.	3*s.* 6*d.*
Microbiological Methods for the Estimation of Amino-Acids.	2*s.* 6*d.*
Production and Modification of Liver Disease by Diet.	1*s.*
The Grasslands of Latin America.	20*s.*
Five Hundred Varieties of Herbage and Fodder Plants.	15*s.*
A Catalogue of the Parasites and Predators of Insect Pests (*8 parts 10s. per part published to date*)	
The Use of Aerial Survery in Forestry and Agriculture.	7*s.* 6*d.*
The Use and Misuse of Shrubs and Trees as Fodder.	9*s.*
The Chemical Composition of Plants as an Index of their Nutritional Status.	9*s.*
Gestation Periods. 2nd edn.	3*s.*
Seed Production of European Vegetables in the Tropics.	2*s.*
Revisions of and Additions to Indian Fungi.	3*s.* 9*d.*
Notes on Indian Fungi. IV.	3*s.*
Revisions of and Additions to Indian Fungi. II.	3*s.*
Land Classification for Land-Use Planning.	4*s.*
Bibliography of Soil Science, Fertilizers and General Agronomy, 1940-44.	30*s.*
The New Genetics in the Soviet Union.	6*s.*
Forest Tree Breeding and Genetics.	5*s.*
Minerals in Pasture Deficiencies and Excesses in Relation to Animal Health.	5*s.*
The Semen of Animals and Its Use for Artificial Insemination.	7*s.* 6*d.*

All correspondence regarding above journals and other publications may be addressed in the first instance to:—

COMMONWEALTH AGRICULTURAL BUREAUX

(Central Sales Branch)

PENGLAIS, ABERYSTWYT, GREAT BRITAIN



G
E F

MYSORE

TRANSFORMERS.

1. Low Magnetic & Current Loadings.
2. Robust Mechanical Construction.
3. Every Modern Feature Incorporated.
4. Inspection by Trained and Qualified Staff at Every Stage of Construction.
5. Every Unit Tested Fully.
6. Guarantee of Free Service for the First Year of Operation.
7. All Units to B.S. Specifications.
8. Any Special Requirements or Design Changes can be incorporated on demand.

Units up to 5,000 K.V.A. 33 K.V.

Suppliers to the Government of Mysore for the past 14 years. Over 200 satisfied customers.

You get more for your money from State-owned Industries.

GOVT. ELECTRIC FACTORY

MYSORE ROAD - - - BANGALORE CITY

THE BANGALORE PRESS